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A LECTURE ON SOME UNUSUAL MANIFESTATIONS OF SYPHILIS IN THE UPPER AIR PASSAGES.*

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Gentlemen—There is no more trite expression than the ever-reiterated designation of syphilis as "protean" in its manifestations, yet it would be hard, I venture to say, to point to any affection in which we have voluntarily bound ourselves to more rigid formalism than in our notions regarding the classification and the treatment of the various stages of that disease. It is an axiom religiously believed in, that we must distinguish between primary, secondary, and tertiary manifestations, separated from one another by certain limitations of time, which are, after all, purely conventional, and when we have decided upon registering an individual case as coming within one of these categories, we again feel it to be our duty to prescribe mercury for the first and second of these stages and iodid of potassium for the third. A convention of this

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kind could of course not have arisen if experience had not taught us that on the whole it answered practical requirements, and far be it from me to shake well-founded belief in the results of such practical experience. From time to time, however, it is well to be reminded that exceptions occur to almost every rule, and that to insist too rigidly upon convention is not wise. Many years ago, I published under a title[1] similar to the one given to this lecture, some instances of rare manifestations of syphilis in the upper air passages, which did not fit into the generally adopted scheme, and having recently had within a comparatively short time the opportunity of seeing a further number of such unusual cases, I avail myself of this opportunity to bring them before the notice of the profession. As they all have occurred in private practice, I shall, for obvious reasons, not give any particulars which could lead to identification of the patients, and for the same reasons shall not mention the names of the practitioners who were good enough to send me the patients or were otherwise concerned in the management of the cases themselves.

1. Precocious Tertiary Syphilis of Throat and Tongue of Malignant Type.

A gentleman was sent to me by his medical adviser with a letter from which I abstract the following statements: A year ago the patient got a hard chancre. It had only just appeared when his doctor saw him. He put him on full doses of mercury at once. None of the ordinary secondary symptoms ever appeared, but the patient got a tremendously swelled throat and tongue, and was badly salivated, ropes of saliva pouring out of his mouth. The soft palate became edematous, the tonsils, on each of which a large ulcer appeared, almost met in the middle, and the patient was very ill generally. The medical attendant considered the phenomena as mercurial. Mercury being left off, the ulceration gradually improved, the salivation diminished, and the patient went away to recoup, but returned with his throat again deeply ulcerated.

In consultation with a specialist the affection was considered to be of the nature of secondary syphilis; a return to mercury was advised and practised, with the result that the ulceration,

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(1) On Some Rare Manifestations of Syphilis in the Larynx and Trachea, Lancet, 1882.

as on the first occasion, grew rapidly worse, and the patient became very ill. Mercury was again abandoned, and the patient was treated with "ordinary throat applications." Temporary improvement occurred, but a month or so afterwards fresh ulceration broke out in the throat. On renewed consultation mercury was again advocated and used, with exactly the same result as previously, namely, that the ulceration immediately became much worse, and that the patient was again very ill. Mercury being discontinued, he very slowly and gradually recovered, and was then sent to a great authority on syphilis who, it was stated, took an intermediate view between syphilis and mercurial ulceration, and considered the former to belong to the phagedenic type. He advised the use of iodid of potassium, which, however, the patient was "unable to take in ordinary doses." All this information was given in a letter, the tone of which was perfectly despairing; the writer, who obviously took the greatest possible interest in his patient, had evidently on each occasion, when, either on his own initiative or following the advice of his consultants, he had tried antispecific remedies, particularly mercury, been so much frightened by the extreme violence of the resulting local symptoms and their bad effect upon the general health of his patient, that he had become firmly convinced that the ulceration was of an exclusively mercurial character, and although he laid the case with the greatest fairness before me, it was quite obvious that his own conviction had become so firmly established that no arguments would easily shake it.

The patient was a pale, unhealthy-looking man, evidently in pain, whose speech was guttural and indistinct, his frequent endeavors at swallowing the saliva, which was constantly produced in large quantities, being accompanied by signs of great distress.

On examination, I found the following condition: There was extensive scarring owing to destructive ulceration of the mucous membrane of the palate and fauces, resulting in adhesions, on the one hand between the soft palate and the posterior wall of the throat, and on the other, of the pillars of the fauces with the sides of the tongue. The uvula was entirely destroyed, and there were two perforations—a larger one above, a smaller one below—in the middle line, the larger one of which represented the only communication between the nasopharyngeal and oral cavities. The tongue showed evidence

of old ulceration and was fissured; the epiglottis was partially thickened, more particularly on the right side, and on this part, as well as on the sides of the fauces, there was still some active superficial ulceration. The interior of the larynx was free. There was no disease in the nose, the cervical glands were hardly enlarged at all, and there was no skin eruption.

From the appearance described there was no doubt in my mind that the affection was of a purely syphilitic character, tertiary in nature, although appearing at an unusually early time, and revealing a most unusual idiosyncrasy on the part of the patient against antiseptic remedies, particularly against mercury. I wrote in this sense to the patient's medical adviser, and mentioned in anticipation of the natural objection that the throat affection had occurred at a time much prior to the usual occurrence of tertiary symptoms, that I had in 1882 described in the *Lancet* a case in which gummata developed in the larynx within the first year from the primary infection, and that I had on the same occasion quoted a case of Mauriac's, in which as early as two and a half months after the primary infection an evolution of gummata took place, and a statement of Zeissl's that he had seen a nodular syphilide four months after the primary infection. At the same time I proposed that the patient should be sent to Aix-la-Chapelle with the primary object of eliciting the opinion of one of the authorities of that place as to the differential diagnosis between mercurialism and syphilis, and, in second line, of the patient's being treated there for syphilis in the event of the opinion being in favor of the manifestations being specific. This advice was adopted.

The opinion of the physician at Aix-la-Chapelle, taken quite independently of me, entirely coincided with my own. He considered the case one of precocious malignant tertiary syphilis, two instances of which affecting the nose he had previously observed himself. He at first tried to treat the patient with iodipine preparations, and made four injections of 25 per cent iodipine, each containing ½ oz. of the drug, this remedy being chosen because, in the experience of my friend at Aix, this form of iodin is equally mild and efficacious. The result was no more successful than had been the mercury and iodin treatment at home. On the day after the last injection the patient got a painful swelling of the tongue. The tongue itself, as well as the soft palate, became covered with a dirty yellowish deposit in the area where previously simple erosions

had been present. This condition got daily worse, and ultimately the entire affected region of mucous membrane became changed into a mass of rather deep and intensely painful ulcers, the general health at the same time deteriorating rapidly. The ulcers were painted with a 10 per cent solution of nitric acid. Under this treatment they became cleaner, but showed no tendency to heal. From this result of the iodipine treatment, the Aix physician became even more convinced than he had been before that he had to deal with a case of malignant syphilis, as in such cases in his experience the inefficiency of mercury and iodin preparations is quite characteristic. The present case additionally, he stated, belonged to a rare variety which he had previously observed, and which is characterized by a tuberculin-like effect of iodine preparations. In such cases the reaction, which ordinarily is quite insignificant, manifests itself by a furious inflammation. This very reaction, in his opinion, made it even more certain that we had to deal with a case of lues, inasmuch as, although mercury may produce ulcerative lesions, such have never been observed under the administration of iodin preparations, often though they be administered, to non-syphilitic persons.

Acting upon this opinion Zittmann's sarsaparilla decoction was prescribed for the patient with immediate and brilliant results. For twenty-six days he daily took in the morning 7 oz. of the stronger Zittmann's decoction, and in the evening 7 oz. of the weaker decoction. This was followed for ten days by Kobert's* sarsaparilla decoction, and finally he took the two Zittmann preparations for another fortnight. Under this treatment his general health improved from day to day, the ulcers cicatrized in the most desirable manner, and ultimately were replaced by a solid scar. The patient's articulation became much more distinct, he could eat without difficulty and pain, and during the whole time hardly ever suffered from diarrhea.

*The formula of this preparation is the following: Place 1 kg. of sarsa root in coarse powder in a closed vessel with 4 kg. of distilled water, and set aside for three hours, occasionally stirring; heat and keep boiling for one hour, then press out. Repeat this once more. Evaporate the combined decoctions until there remains 1 litre (quart), mix well with an equal volume of alcohol (90 per cent), wash out the residue with boiling alcohol (90 per cent) ½ litre, strain through flannel and filter, evaporate to ½ litre or less. Establish the quantity of parilli and sarsaponia according to the method of v. Schulz-Christophson, and adjust the strength of the finished product either by evaporating or by adding distilled water, so that it shall contain 2 per cent of the above glucosides.

He was discharged with the advice to take Kobert's decoction for another fortnight, and afterwards to discontinue for a time all treatment. When I saw him on his return I found a most pleasing improvement; a dense cicatrix united the remnants of the soft palate with the lateral wall of the pharynx down to the level of the epiglottis. In its midst there was one sharp-cut perforation, and the uvula, as already stated, had completely perished. There was no active ulceration in the pharynx and the larynx was normal. The patient's general appearance and articulation were infinitely better than before he went to Aix. Since then, so far as I know, he has remained perfectly well.

2. Tertiary Syphilis of Larynx and Trachea followed by Isolated Tertiary Syphilis of the Naso-pharyngeal Cavity.

A married lady was brought to me on account of gradually increasing loss of voice and dyspnea, which had come on, it was stated, during the preceding ten days, after a bronchial catarrh. The patient complained of loss of voice and some slight difficulty in swallowing, but, curiously enough, did not attach any importance to the difficulty in breathing, although this was clearly manifested by distinct stridor even during quiet respiration. Tuberculosis had been suspected on account of the laryngeal appearances to be described presently, but two examinations of the sputum made by the Clinical Research Association had failed to disclose any bacilli. There was no history whatever of syphilis.

On examination of the almost aphonic patient it was seen that the left half of the larynx was fixed, and that the left vocal cord, which was distinctly edematous, was bent outwards in its posterior part. The right vocal cord, which was quite white, moved normally. A long way down into the trachea, it was seen that from the walls of the tube on both sides reddish projections extended into the interior, those on the left side projecting more than those on the right. The calibre of the tube was thereby narrowed to such a narrow split that it was surprising that the patient had not got even greater dyspnea. The larynx made no respiratory excursions. There was tenderness on pressure over the front part of the cricoid cartilage. On examination of the chest the tracheal stridor was found to be conducted all over the chest, and nothing else could be heard. There was no skin eruption.

In spite of the absence of a syphilitic history, I diagnosed gummatous infiltration of the larynx and trachea, and sent the patient at once to a home, where she was put to bed with a Leiter's tube round her neck, whilst iodid of potassium in 10-gr. doses and liquor hydrarg. perchloridi in 1-drachm doses three times a day were prescribed for her. It was explained to her and her husband that tracheotomy might become necessary, unless the disease quickly yielded to the treatment prescribed. Fortunately, already on the next day the stridor had somewhat diminished, the patient having passed a good night. From the second day onwards mercurial inunctions according to Zeissl's plan were instituted. This consists, as I have described in the *Lancet,* 1882, in the following: "Twenty grains of mercury ointment were daily rubbed into various parts. On the first day the ointment was applied to the skin of the neck over the larynx, second day to the inner surfaces of both upper arms, third day to the inner surfaces of both thighs, fourth day to the inner surfaces of both forearms, fifth day to the inner surfaces of both calves, sixth day to the skin over both loins, seventh day to the skin of the back." This series is to be repeated four times in the same order, each series being preceded and followed by a warm bath, and astringent gargles being used as a matter of course during the whole time.

Under this treament both the subjective and objective symptoms described rapidly disappeared, and six days after the first consultation practically no trace of the previous serious illness could be detected in either larynx or trachea. The patient went home, but was urgently admonished to continue the inunction treatment for another month. Whether this advice was strictly followed I am unable to say. At any rate, hardly three months later the patient began to suffer from sudden deafness and suppurative otitis media in both ears. At the same time an obstruction to breathing existed, which was located between the nose and throat, and a large ulcerating swelling, evidently of gummatous nature, was found to cover the vault of the pharynx and the upper part of its posterior wall. These manifestations again quickly yielded to mercury and iodid of potassium. In view, however, of the fact that twice within a short time gummata had formed in such dangerous situations, I strongly advised the patient to go to Aix-la-Chapelle, in order to be radically cured, if possible. The patient followed my advice, was energetically treated with inunctions and at the same time with injections of iodipine, while local applications

of nitrate of silver were made in the pharynx and nasopharynx to promote quicker healing. Under this treatment complete recovery ensued. The patient six months afterwards once more went to Aix-la-Chapelle to undergo a short inunction treatment as a prophylactic, and has ever since remained perfectly well.

3. Early Fibroid Infiltration of Pharynx and Larynx in a Case of Obstinate Recurring Secondary Syphilis.

The patient was a gentleman, who had been very liable to tonsillitis and pharyngitis for many years. Some years previously he had a hard chancre in the urethral orifice and hard glands in the groins. Hydrargyrum cum creta was given in 1-gr. doses three times daily for four months, under which treatment the chancre and inguinal glands soon disappeared. Hardly any secondary rash occurred, but about six months after the primary infection his throat began to trouble him, his voice become hoarse, and he had difficulty in swallowing. He was then sent to me, and I found a characteristic mucous patch on his right tonsil, whilst the corresponding region on the left tonsil looked suspicious. In the larynx there was marked diffused general thickening of the epiglottis and of the arytenoid cartilages, and the vocal cords were congested. The aspect of the larynx was such that, without the history of syphilis, one would have thought rather of the pseudo-edematous swelling often ushering in laryngeal tuberculosis than of syphilis, but the fact that a characteristic pharyngeal affection existed at the same time, and that, further, the laryngeal swelling was of a much more dusky color than is usually seen in laryngeal tuberculosis, militated against the tuberculous theory. In addition, on careful examination of the lungs no evidence of tuberculous disease was found, and the absence of constitutional symptoms, except some emaciation which was admitted, seemed to point in the same direction. All the same, the possibility of a combination of syphilis and tuberculosis was not lost sight of. From the very first, however, I inclined rather to the belief that this was a case of syphilis pure and simple, appearing in the larynx in the somewhat unusual form of early general fibroid thickening, than a combination of syphilis and tuberculosis.

The weight and temperature of the patient were registered carefully for a while, and his sputum was repeatedly examined

for tubercle bacilli. The results were perfectly negative, and the idea of the presence of a combination between tuberculosis and syphilis could therefore be entirely abandoned.

Whilst the syphilitic phenomena in the pharynx were of such a fleeting character that they varied almost from day to day, the aspect of the larynx remained for a time stationary, in spite of continued treatment by oral administrations of mercury, and the patient ultimately decided to go to Aix-la-Chapelle. There he underwent energetic mercurial inunction treatment, with the result that the general infiltration of the larynx very much decreased, and he returned greatly improved. Shortly afterwards, however, fresh mucous patches appeared in the pharynx, a roseolar eruption broke out on his skin, and so considerable an increase of the infiltration of the larynx was noted that I feel sure that nobody seeing the patient then for the first time would have doubted that the condition represented the infiltration stage of laryngeal tuberculosis. He complained of pain in the shin bones, occipital headache, and a general feeling of malaise. Together with these phenomena, syphilophobia of a marked type developed. He commenced to take note of the smallest objective and subjective symptoms in his case, and became greatly depressed. Renewed physical and bacteriologic examinations not having afforded the least evidence of the existence of tuberculosis, Kobert's sarsaparilla decoction was given, but without effecting any improvement. The patient's syphilophobia had by that time increased to such a degree that it became extremely difficult to manage the case. At last iodid of potassium was tried, which I had so far fought shy of, because in view of the already existing infiltration of the larynx I had feared that possibly it might produce laryngeal edema. Its effects, however, were very pleasing. The infiltration materially decreased, the skin eruption disappeared, the difficulty in swallowing, which previous to the administration of the iodid had returned with increased severity, quite vanished, and the patient's voice, which at that time was very hoarse, became natural again. At the same time his general health very much improved, he became more hopeful, and matters at last took a more favorable turn. Quite recently I have heard that under the continuation of liberal doses of iodids his throat symptoms were kept in abeyance as long as he was under observation, but that until the very end he continued to be very nervous about himself, and was always on the look-out for every little adverse symptom.

4. Tertiary Syphilis of the Larynx Manifested Particularly by Periodical Inflammation, with Production of Ephemeral Papillomatous Excrescences.

A gentleman consulted me on account of persistent hoarseness, from which he had suffered for a long time. He at once stated that thirteen years previously he had had a hard chancre, and had since then frequently suffered from cutaneous eruptions and ulceration of the tongue. On examination nothing wrong could be detected on the skin, on the tongue, in the mouth, or in the pharynx, but there was considerable thickening, inflammation, and ulceration of the epiglottis, the free edge of which showed several deeply-cut ulcers. The mucous membrane over the arytenoid cartilages also was greatly inflamed and thickened. The movements of the left arytenoid were deficient. The vocal cords were changed into two rounded cylindrical bodies, but were not ulcerated.

As there could be no doubt that the patient was suffering from syphilitic disease of the larynx of a serious type, and as he had repeatedly and for a long time taken mercurial preparations by the mouth without obtaining a cure, I advised him to start at once for Aix-la-Chapelle in order to undergo a thorough inunction treatment. He followed my advice, with the result that a very considerable general improvement took place; the vocal cords lost their roller-like appearance, and appeared merely slightly congested when he returned, and the thickening about the left arytenoid cartilage became much diminished, although its movements were not entirely regained. After his return he took for some time hydrargyrum oxydulatum tannicum (5 gr. daily) in the form of pills. Unfortunately, however, the improvement was not of long duration. About fifteen months after his return I saw him again, when he spoke with an extremely thick voice, and there was occasional inspiratory stridor. He had had several apparently rather severe choking fits. On examination the epiglottis was seen to be considerably more thickened than it had been, and the outward movements of both vocal cords, particularly of the left, were very deficient. There was also some fresh ulceration on the epiglottis, and the general thickening of the mucous membrane over the arytenoids had increased. I was afraid that the case would turn into one of those serious instances of general fibroid syphilitic laryngitis in which often ultimately tracheotomy and the constant wearing of a tube become neces-

sary, and strongly advised that he should immediately return to Aix and go again through a thorough inunction treatment. To this he agreed.

The report from Aix was this time not so satisfactory as after his first visit. The patient during his stay contracted acute bronchitis after which the infiltration of the epiglottis increased to nearly double its former size. Although some improvement of this condition took place when the bronchitis subsided, the epiglottis remained much more thickened than it had been previously. The arytenoid cartilages diminished in size under the influence of the mercurial inunctions, but now for the first time nodular excrescences made their appearance upon the vocal cords. Before leaving Aix the patient was advised to take sarsaparilla decoction for some time after his return.

When I saw him after his arrival here, the appearances were even less favorable than I should have anticipated from the Aix report. The epiglottis itself was less swollen than I had ever seen it, and there was no trace of active ulceration. The mucous membrane over the arytenoids, however, was still much thickened, and considerable swelling was seen in the front parts of the ventricular bands, so much so that at first sight it looked as if these parts had actually grown together. There was also a great deal of irregular nodular fibroid thickening of the left vocal cord and in the interarytenoid fold, as well as of the posterior part of the right vocal cord. Curiously enough, there was no dyspnea, but the voice was certainly not so good as it had been the previous winter. On examination of the chest nothing wrong could be detected.

From this time onward the disease changed its character in the most remarkable manner. Whilst previously its manifestations had been mostly of the nature of apparently fibroid, deep-seated infiltration, and to some extent of ulceration, these phenomena for a considerable time receded, and were indeed at times conspicuous by almost complete absence. Their place, however, was unfortunately taken by a periodical sprouting of irregular pale excrescences, occasionally condylomatous, but more frequently papillomatous, in shape, which arose sometimes more slowly, sometimes with almost incredible rapidity, from almost any part of the interior of the larynx, but most frequently from the vocal cords themselves, from the interarytenoid fold, and from the ventricular bands. After having been in existence for variable lengths of time, they then always

completely disappeared, sometimes spontaneously, sometimes under the influence of antiseptic treatment, either gradually or quickly, just as they had made their appearance. In fact, the aspect of the larynx varied at different times like the figures of a kaleidoscope, and unless I had had the privilege of following these changes up myself, I should not have considered it possible that such grave alterations, as I repeatedly had the opportunity of observing, could be followed by such an almost complete restitution of normal conditions. I need hardly say that the subjective symptoms corresponded with the objective ones. Whilst during those periods when the larynx was filled almost completely with excrescences the voice was extremely hoarse or even almost aphonic, and the respiration noisy and stridulous, in the free intervals there was hardly any hoarseness and the breathing was quite free. These ups and downs were of course attended with a good deal of anxiety and excitement. Several times tracheotomy seemed to be almost immediately required, and more than once I was greatly tempted to remove part, or the whole, of the obstructing masses by intralaryngeal operations. What induced me to withhold my hand was the ever repeated observation that the growths after all always disappeared either spontaneously, or, more frequently, under the direct influence of constitutional treatment; and what prevented me particularly from having recourse to intralaryngeal instrumentation was the consideration that syphilitic scars, as is well known, have a great tendency to extreme contraction. For this reason I was afraid that wounds produced by intralaryngeal removal of the excrescences might lead to lasting stenosis.

Several years passed with such fluctuations as those described. The patient frequently went to Aix, and was each time very considerably benefited, although unfortunately never lastingly cured. Yet there never seemed to be any tendency towards the establishment of irreparable grave changes in the larynx, and never during the time that he was under my care did syphilitic manifestations occur in any other part of the body. In a report which I sent to my friend at Aix several years after the patient had been under my observation I find the following note: "I am surprised beyond measure at the enormous improvement which has recently taken place in the condition of the larynx. The swelling of the epiglottis and of the arytenoid cartilages, the mobility of the vocal cords, and the shape of the latter are so astonishingly improved,

that, with all my previous experience, I have never seen such a change for the better as has taken place in this case; and, indeed, I should have considered such an improvement impossible to occur after so much apparently organic infiltration, if I had not seen it with my own eyes. Quite corresponding with this objective improvement the voice, when I saw him a few weeks ago, was marvellously better."

Unfortunately, again, this improvement was not destined to last long. At Aix fresh excrescences appeared on the vocal cords with such astounding rapidity that tracheotomy at one time was considered unavoidable, and I was requested to hold myself in readiness to perform it. Again, however, a sudden improvement—almost overnight—occurred, and the operation could again be postponed.

At that time the patient sought other aid, and for a time I lost sight of him. Later on I was informed that a few months after his last visit to Aix a fresh aggravation took place, and that at last tracheotomy had to be performed under circumstances of great distress, the stenosis having attained an extreme degree before relief was given. The patient then underwent a long series of intralaryngeal operations, partly of a cutting, partly of a caustic, nature, in the course of which a very large quantity of new growths were stated to have been removed. Throughout all that time he had to wear his cannula on account of the still existing stenosis. Recently he returned to me, when I took the following notes:

Crico-tracheotomy has been performed. The patient is still wearing his tube, although it is corked up. The epiglottis is slightly thickened and a little irregular, but not markedly so. The left cord stands almost motionless near the middle line, and is only very slightly abducted during forced inspiration. There is considerable adhesion between its anterior third and that of the right vocal cord. The latter is clotted together with the right ventricular band into one reddish mass. The right arytenoid cartilage is very little abducted in inspiration. The chink of the glottis is reduced to a very narrow, irregular gap in the posterior part of the organ, through which occasionally the shining silver cannula can be seen. The voice is reduced to an absolutely toneless whisper. No active disease can be seen at present in the larynx, and it is stated that for about a year's time no active manifestations of syphilis have made their appearance. Tracheoscopic examination does not reveal any mischief below the level of the vocal cords.

The patient was very anxious to get rid of his tube. His present medical adviser, however, very properly seemed to hesitate on account of the risk of sudden obstruction of the narrow glottis in the event of an acute catarrh. I strongly supported this cautious attitude in view of both the existing stenosis and the possibility of further attacks of the disease itself, and suggested that under all circumstances before an attempt were made to lastingly remove the tube, the adhesions in the front part of the larynx should be split with a cutting dilator, and for a long time dilating tubes, such as Schroetter's, should be introduced into the larynx with a view of further and sufficiently enlarging the calibre of the glottic aperture. At the same time I stated that I considered it possible that the voice might become a little stronger when the adhesions had been divided, although of course restoration of natural voice could hardly ever be hoped for.

Remarks.

The four cases just narrated well illustrate, I think, the thesis from which I started, that is, that whilst ordinarily it is easy enough to follow the established canons with regard to the diagnosis and treatment of manifestations of syphilis in the upper air passages, yet cases occur in which it is imperative not to be fettered by rigid formulas, and to judge anomalous instances on their own merits only, and not on the strength of general rules. Apart from enforcing this general lesson, each of the four cases offers some important points for consideration. In the first case it is the occurrence of severe tertiary lesions so shortly after the primary infection, and the uselessness, not merely, but the direct deleteriousness of the recognized antispecifics, which confer a particular interest upon it. As to the precocious occurrence of tertiary symptoms, this is, as already stated, although a rare, yet a by no means unheard-of occurrence. Much more exceptional is the damaging effect exercised upon syphilitic lesions by both mercurial and iodin preparations. So tangibly serious were the effects of mercury in this case, that there is little room for wonder that the distinguished practitioner who sent the patient to me for an opinion became firmly convinced that the phenomena seen by him were actually due to mercurial poisoning, a view to which he even now adheres. My reasons for thinking otherwise are the following:

First, we are all familiar with the effects of mercurial poison-

ing when appearing in the throat; we know the stomatitis, the profuse ptyalism, the ulceration of the interior of the cheeks, the fungosity of the gums, and the decay of the teeth; but I am not aware that ever a case has been described in which conditions such as those observed in this case—destructive ulceration of the mucous membrane of the palate and fauces, loss of the uvula, perforation of the hard and soft palate, extensive ulceration of the tongue, extensive cicatricial adhesions—have ever been observed as a result of mercurial poisoning.

Secondly, as already stated, it is of great importance that damaging influence was exercised upon the process, not only by mercurial but also by iodin preparations, and here it is particularly noteworthy, as insisted upon by the physician at Aix-la-Chapelle, that actual ulceration followed the administration of iodin, whether administered by the mouth or by subcutaneous injections, a result never produced in ordinary cases of idiosyncrasy against iodin preparations. However violent the symptoms of iodism may be—I have seen several very instructive instances of the kind—active ulceration has never been amongst them.

Thirdly, it is particularly important that twice in this case, before the patient came and saw me, active ulceration had made its reappearance spontaneously a long time after mercury had been discontinued.

Fourthly and lastly, the condition left behind after the period of ulceration is so absolutely characteristic of the ravages of tertiary syphilis, that I feel sure that every experienced observer who were to see the patient now for the first time would, without a second's hesitation, declare that the lesions were due to tertiary syphilis.

I therefore feel perfectly justified in bringing the case under your notice as an instance of malignant, precocious tertiary syphilis, and in recommending to you in similar cases not to persist with the administration of mercury and iodids, but to have recourse to sarsaparilla in the form of Zittmann's and Kobert's decoctions.

The second case—the one in which tertiary syphilis of the larynx, and especially of the trachea, was followed by isolated syphilis of the nasopharyngeal cavity—offers a good illustration of the truth of the, if somewhat cynical, yet excellent, advice: "Whenever you have to do with a particularly obscure case, think of syphilis as a possible cause." Here was a married lady of unimpeachable antecedents and without the least history of syphilis, who at a mature age suddenly developed

the serious symptoms described. It is the absence of the syphilitic history to which I would particularly draw your attention, and from which I would again deduce the lesson, which I have been endeavoring to enforce on more than one previous occasion—namely, to trust to the evidence of your own eyes rather than to the absence of a characteristic history. From what has come under my own notice on a good many occasions, I think it is desirable that this necessity should periodically be emphasized. At the same time, I would take the opportunity of urging the need of the utmost caution, when dealing with such cases, to guard against any imprudent expression of opinion as to the nature of the case you have to deal with. In no class of cases are tact and diplomacy more required than when dealing with syphilis in married people, and the attendant should always remember that a single incautious remark of his may forever destroy the happiness of a family. When remembering the incidents of the case now under consideration, the necessity of such a warning is very deeply impressed upon me. Quite apart from these points, the case is also remarkable for the fact that one not very common localization of tertiary syphilis—namely, gummatous infiltration of the trachea—was followed within a very short time by an even rarer one—namely, the formation of a gumma in the nasopharyngeal cavity.

In the third case two points deserve special attention—namely, first, the occurrence of extensive infiltration of the larynx shortly after infection, and at a time when the ordinary phenomena of the second stage, namely, roseola on the skin and mucous patches in the pharynx, were still present; and, secondly, the terrible syphilophobia to which the patient became a victim after repeated recurrences of the disease. With regard to the first point, I would say that in my own opinion this was a case in which secondary and tertiary symptoms intermixed—an occurrence the possibility of which ought always to be kept in mind. Ordinarily, in secondary syphilis of the larynx the phenomena are simply those of erythema; more rarely do we meet with formation of condylomata and with actual superficial ulceration. I have never previously seen so extensive an infiltration of the larynx take place in genuine secondary syphilis, nor am I aware that such has ever been described. Another reason why I am inclined to look upon the laryngeal phenomena observed in this case as belonging to the tertiary period is the failure of mercury to prevent recurrence of the symptoms, whilst the disease, as long as the

patient was under observation, was kept under control by iodin preparations. I am sorry I cannot say what ultimately became of the patient, my endeavors to trace him having failed. Whilst one could not help sympathizing greatly with the poor man in his recurring tribulations, the syphilophobia which he developed ultimately became almost as trying to his medical advisers as to himself. In such cases the medical attendant must not merely be an adviser of the body, but also of the soul. Some unfortunate syphilophobes fall into a condition of melancholy, others become quite frenzied, and not merely threaten but are actually apt to commit suicide. Under such circumstances it is the duty and the privilege of the medical adviser to maintain courage, to cheer up, and to always hold out the hope of ultimate and lasting recovery. A despondent attitude on the part of the medical attendant is the surest way to drive the patient into utter despair.

The last case is, without exception, the most unusual instance of syphilis in the upper air passages which I have ever met. I have made it a point to look through literature with a view of discovering whether ever a similar case had been described, but have not found one. Whatever the causes were which repeatedly produced new growths—which almost completely filled the patient's larynx, then made them disappear, leaving the organ but little disfigured, and then again and again produced fresh crops, to be followed by similar disappearance—I am quite unable to say. Nor can I explain, in view of the long interval before the patient's last visit, in precisely what manner the present condition of his larynx has come about.

In conclusion, gentlemen, let me say that the simple narrative I have given illustrates, I think, better than any elaborate commentaries, how little one single form of antisyphilitic treatment can claim to be universally successful in all cases. In the great majority of my own cases of syphilis of the upper air passages, methodical inunction treatment has been most successful, and I trust this more than any other method. Yet you have heard that in two out of these four cases it failed. The therapeutic lesson to be derived from the experiences gained in these four cases, it seems to me, is that as in diagnosis so in the treatment of syphilis, it must be our aim to individualize when the ordinary canons show themselves insufficient to cope with the particular case, and not to insist on preconceived notions of any kind.

XVII.

AN UNUSUAL GROWTH OF THE MASTOID PROCESS, FIBRO-CHONDRO-OSTEOMA OF THE MASTOID ANTRUM.*

By S. MacCuen Smith, M. D.

PHILADELPHIA.

The following case is of interest, in the first place from the fact that a growth was found in the mastoid antrum during an operation for chronic otorrhea, but more especially on account of it being attached to the necrotic surface by one short slender pedicle, and yet the pathologic examination showed it to be composed of fibrous, cartilaginous and osseous structure. When first observed it resembled a fibrous polypoid growth, was movable in all directions within the radius of its pedicular attachment, and did not bleed when detached from its thread-like pedicle.

The history of the patient is as follows: Master M. L., 16 years of age, was born of healthy parents, and never suffered from any diseases peculiar to childhood except measles when four years of age, and his parents are not aware of his having had any ear complication from this illness. His only other illness was a severe attack of typhoid fever two years ago, from which, so far as is known, he made a good recovery without any suggestion of aural involvement. The patient, as well as his parents, deny positively that he ever had any trouble with his ears until about the middle of November, 1905, when it was noticed that the hearing of the left ear was rapidly becoming impaired. His physician was consulted and on examination found some foreign matter in the ear which he diagnosed as "wax," which forceful syringing, however, did not remove. Forceps were then resorted to and the traction produced marked vertigo and some bleeding, at the sight of which the physician became alarmed and sent him to the Jefferson Hospital the following day, where he came under the care of the writer. An examination showed a large fibrous

*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society.

polypoid growth filling the entire canal, the pedicle apparently having its origin in the tympanic cavity.

He was admitted to the Jefferson Medical College Hospital on December 6th, 1905, and operated on the following day. After removing the growth, we found an extensive hyperostosis of the posterior wall of the external auditory canal, which so far obstructed the lumen of the canal that the tympanic membrane could not be seen. As a very foul odor came from the brownish-yellow discharge that escaped following the removal of the polypus, we concluded to perform a radical mastoid operation as a means of correcting the hyperostosis and the evident necrosis of the tympanic cavity and mastoid antrum.

The entire mastoid process was of the eburnated variety until the antrum was reached, which forced the conclusion that the case was, after all, of the usual chronic nature, notwithstanding the protestations on the part of the patient and his family to the contrary. The antrum and tympanic cavity were extensively involved in the necrotic process, while the malleus and incus had become disintegrated, probably some months or years ago, and made their escape in the discharge.

The tumor was located in the inferior and anterior part of the antrum, and filled in the concavity caused by the more or less drooping of the canal adjacent to the hyperostosis.

Growth, natural size.

The following is the report received from the Jefferson Hospital pathologist, who made the examination of the tumor: "The specimen is an ovoidal mass 1 cm. long, 0.6 cm. wide and 0.3 cm. thick; weight 0.2 gm. The surface is smooth, glossy, slightly nodular and greyish-pink in color. The tissue is hard at some points and soft and elastic at others.

The specimen was fixed in Zenker's solution, decalcified in 10 per cent nitric acid, then dehydrated, infiltrated with paraffin, sectioned and stained with polychrome blue, hematoxylin and Van Giesen, also eosin.

Histology:—The sections are almost completely marginated by stratified squamous epithelium. At some points in this structure the four layers of the epidermis—the strata cornea, lucida, granulosa and Malpighii—can be distinguished, while at others but a few rows of the strata cornea and Malpighii are present. Typic prickle cells are not demonstrable. The stratum papillare of the corium presents numerous elevations and depressions where the epidermis is thick and shows all its layers, but is absent where but a few rows of the corneal and Malpighian strata are in evidence. That part of the margin not covered by skin is formed by a band of fibrous tissue and this is probably the point of attachment of the specimen to the contiguous tissues. Beneath the skin are areas composed of loosely-woven strands of fibrous tissue transmitting numerous small bloodvessels; at points the perivascular structures are densely infiltrated with mononuclear leukocytes. The sections also contain trabeculae of fibro-cartilage and here and there harder and denser areas, osteoid in character, which necessitated decalcification in order to section the specimen. At the sides of this cartilaginous tissue are numerous multinuclear cells varying from 40 mikra to 70 mikra in length and from 10u to 25u in breadth. These cellular elements are indistinguishable from chondroblasts and near them the cartilage is eroded and degenerated; this destroyed tissue is being replaced by a loosely-woven, fibrillated and cellular fibrosa. In the structures between the cartilaginous trabeculae are numerous large lymph sinuses, some of them empty, while others contain a granular acidophilic material.

Diagnosis:—Fibro-chondro-osteoma of the mastoid antrum.

XVIII.

THE INDICATIONS FOR OPERATIVE INTERFERENCE IN MASTOIDITIS ASSOCIATED WITH ACUTE SUPPURATIVE OTITIS MEDIA.

By T. Melville Hardie, M. D.,

CHICAGO.

It is difficult to believe that practically all of the life-saving work in ear diseases has been limited to the past thirty-five years. (Schwartze's work was published in 1873.) Before that time mastoid operations were not performed unless a perforation of the cortex of the bone had taken place with consequent swelling, redness and fluctuation over the mastoid process, and even at the present time it is possible to meet practitioners of medicine who have never observed a case of mastoid inflammation which demanded operation, although they have had patients succumb to one or other of the well-known intracranial or general complications or sequelae of the disease.

It should be possible for everyone to decide in a large proportion of cases whether operation is necessary. In the remaining number he can obtain assistance in every city which possesses an oculist and aurist who can use a head mirror and ear speculum as well as he can his ophthalmoscope.

The formulation of rules for the guidance of the inexperienced is always a difficult undertaking, and in this case the difficulty is increased from the fact that the structure of the parts involved and the virulence of the infection are so variable that the symptoms, subjective and objective, vary likewise, even when the pathologic conditions within the bone are similar, and my single suggestion is that if we err at all it should be on the side of safety. One should operate too early rather than too late. We may now proceed to an enumeration and description of the symptoms which demand operation.

1. *Pain.*—Consider its duration, situation and severity. Pain in the mastoid region is a very common symptom. It is frequently described by the patient as deep, boring, nauseating, usually worse at night. It is often just severe enough to cause

sleeplessness. It may have come on with the acute inflammation in the ear, or it may not develop until some days after the ear has begun to discharge, or it may begin only when the previously profuse discharge from the ear has suddenly stopped.

Pain on pressure is a very important symptom of mastoid disease, but care must be taken both as to the method of eliciting tenderness and the situations chosen for its early demonstration. It must be remembered that very gentle pressure over an acutely inflamed periosteum might cause excruciating pain, while deep pressure would be required to elicit pain when the inflammation was deeply seated in a bone, the structure of which was dense and compact.

Pressure, therefore, with the end of the thumb or forefinger is to be slowly and steadily increased over the antrum, the mastoid tip and the region of the mastoid foramen. When endeavoring to elicit antrum tenderness, the pressure is to be made just behind the auricular attachment and upwards and backwards from the external canal. Care must be taken, if there is any question as to the co-existence of mastoid disease and furuncle of the external meatus, that neither the ear nor the cartilaginous meatus is moved. When examining the tip be sure to compare the two sides, as the normal tip is often sensitive to pressure.

Tenderness on pressure over the emissary vein which comes out through the mastoid foramen is also important, even although its presence does not indicate thrombosis of the sinus.

Finally, it is to be remembered that exceptionally cases of mastoid disease exist in the absence of pain on pressure, and that not merely furuncle but occasional otalgias of hysterical or other origin may attempt to confuse us. Of equal importance, therefore, from a diagnostic standpoint, is the information we obtain by an examination of the external canal and drumhead.

2. The drumhead is markedly bulged forward or outward frequently even after perforation has taken place. The perforation is oftenest situated on the apex of this projection, in the posterior superior quadrant of the drumhead.

3. Of even greater importance and, when it is present, a positive indication for performing the operation, is bulging or sagging of the skin of the posterior superior wall of the meatus, near the drumhead. In this case, again, external otitis (furuncle) is to be excluded.

Symptoms 2 and 3 require upon the part of the examiner ability to use the head mirror and ear speculum. Seeing in this case is not merely believing but knowing, and the writer has always believed that the greatest service one can render his students in otology is to teach them the use of the mirror, so that their inspection of the drumhead may be adequate. It is worthy of mention that this symptom may be absent or not marked in cases in which, while there is free drainage from the middle ear and antrum, an abscess exists at the mastoid tip.

4. *Discharge.*—Very frequently the discharge of pus is profuse, and if this has lasted for a week or more the necessity for operation is probable. In many cases the discharge suddenly diminishes greatly, or stops altogether, while the process in the mastoid progresses. A bacteriologic examination of the pus is advisable, since, when the infection is due to streptococcus or pneumococcus, operation should be performed earlier, and the infection is likely to be more severe. This is particularly true of cases occurring in children.

The old-time symptom of edematous swelling, or swelling and reddening of the skin of the mastoid very often indicates neglect. When this is marked the auricle stands away from the head, and if this occurs after the disease has existed for some weeks, extensive absorption of bone in the process and frequently perforation of the cortex has taken place. If the swelling occurs early the abscess is superficial, or the edema and other inflammatory symptoms are due to the periostitis associated with furuncle of the canal.

6. Another local symptom is a marked increase in temperature of the affected as compared with the sound mastoid.

7. Percussion of the mastoid performed with index finger or small hammer, is to be regarded of diagnostic value if used in connection with other symptoms, especially if the dulness develops while the patient is under observation, but its value as a diagnostic aid is very limited because there is sometimes no difference in the percussion sound of the healthy and the diseased mastoid, and the sound may differ in the two normal mastoids of the same individual. Further, it cannot be used when there is swelling over the process. (Politzer, Diseases of the Ear, p. 504).

8. Andrews' test to determine the density of the mastoid, and hence the presence or absence of disease, is open to the

same objections since it depends upon the same physical laws. Andrews' test (Laryngoscope X., 416) is made by placing a stethoscope with a small bell over the tip and placing the handle of a C_2 tuning fork over the antrum. It is found that when the mastoid cells are filled with pus or granulations, or when the density is increased from bone proliferation, the sound waves are transmitted to the ears of the examiner with greater intensity and for a longer time than occurs when the mastoid is normal. No traction should be made upon the soft tissues since this will increase the sound.

9. I have said nothing, as yet, of the systemic manifestations of the disease because they are not, as a rule, characteristic. Usually temperature, pulse and respiration are not materially affected excepting in children, in whom the temperature may rise to 104° F., even in uncomplicated cases. While there is usually a slight elevation of temperature in adults, and frequently one going to 101° or 102° F., fever may be entirely lacking. (Grunert A. f. O. XXXV.)

Decided prostration, indisposition to exertion, when present, are suggestive. Chills, vertigo, nausea, vomiting, sweating, are unusual excepting in the presence of intracranial complications. These occur more frequently in chronic cases but must always be looked for, since operation must be performed promptly in the event of their onset.

Every case of acute mastoiditis complicating acute suppurative otitis media should, of course, have the benefit of preliminary antiphlogistic, or so-called abortive, treatment before operation upon the mastoid is undertaken. This will include the free incision of the drumhead in the upper posterior quadrant and including the sagging inner portion of the posterior wall. Cold, either by means of the Leiter coil (of aluminum) or thin rubber ice bag should be applied for not longer than forty-eight hours. Too prolonged use of the ice is to be avoided since by its use the symptoms are masked. For the same reason analgesics should be administered only with caution and stinginess.

It has been claimed by Politzer and others of his school that the surgeon should not operate, in the absence of symptoms pointing to intracranial involvement, before eight or ten days after the onset of mastoid symptoms, since it takes that time for the frequently disseminated foci of infection to coalesce or to become evident to the eye of the operator. This

caution is to be observed particularly by surgeons who do not practice a complete exenteration of the process and cells extending into the zygoma.

With this contention the writer is not in accord. The fact that many cases recover without operation does not balance the lives lost through delayed operation. The three considerations that all cases of acute suppurative otitis media exhibit pathologically antral and mastoid involvement, that cases of intracranial trouble are not infrequent, and that all of the chronic cases which give us so much trouble were originally acute, should determine the earlier and more frequent performance of this very safe and rather easily performed operation.

34 Washington Street.

XIX.

A CASE OF PRIMARY SYPHILITIC INFECTION IN THE NOSE.*

By James T. Campbell, M. D.,

PROFESSOR OF OTOLOGY, RHINOLOGY AND LARYNGOLOGY, IN THE POST GRADUATE MEDICAL SCHOOL, CHICAGO.

Chancre of the nose is one of the rarest of lesions. Krefting (Archives für Dermatologie und Syphilis, 1894, Vol. 26, pp. 167) gives statistics of 2,916 cases of chancres, of which 539 were instances of extra-genital infection, and Salsetto (Sifilomi Extragenatali et Epidermie di Sifilide, Brochure, Turin, 1892) records 201 cases of extra-genital chancre with no case of primary nasal infection. Bulkley (Syphilis in the Innocent) gives a table of 9,058 cases of extra-genital chancre in which primary infection of the nose occurred 95 times. Bosworth (A Treatise on the Nose and Throat, 1889) states that in 2,244 cases of chancre observed by Bossereau, Clerq, Lefort, Fornier and Ricord, the primary lesion was found twice in the nose. Le Bart (These dé Paris, 1894) reports 37 cases of primary nasal chancre, of which 21 were external and 16 within the nostril.

The earliest recorded case I can find is that of McCarthy (These dé Paris, 1844). Spencer Watson (Medical Times and Gazette, 1881, Vol. 1, p. 428) reported a case of a nurse in attendance on a woman who gave birth to a syphilitic child. The sore could not be distinctly seen, on account of the swelling within the nostril. Severe pain, fever and mental depression was followed by the ordinary symptoms of secondary syphilis. The vehicle of infection, in all probability, was the patient's own finger.

Intra-nasal inoculations occur most frequently in the lower and anterior part of the nasal septum, next in frequency on the ala and then, as in the case I am about to report, on the inferior turbinated body.

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*Read before the Chicago Laryngological and Rhinological Society, Feb. 13, 1906.

The location modifies the chancre's appearance.

On the septum it displays a flat reddish or greenish, fungiform mass with indurated circumference. The surrounding mucous membrane is to a greater or less degree swollen, and there flows from the ofttimes stenosed nostril a bloody, fetid discharge.

When the ala is involved the infiltration and induration often causes it to be of a cartilaginous consistency.

When the inferior turbinated is primarily inoculated the appearance resembles mostly a severe localized influenza, or a fibrinous or diphtheritic rhinitis. Usually the submaxillary, sublingual and preauricular glands early show marked indolent swelling.

Characteristic of this infection is an aggravated general febrile disturbance, malaise and depression of spirits.

The chancre may be mistaken for an abscess of or injury to the septum; for a furuncle to which for a time it is not dissimilar; for vaccine inoculation; for tubercular ulceration; for malignant disease.

The existence of an ulcer in the nose with a peculiar hard base and granular surface, bleeding easily on touch and of limited extent, would suggest tuberculosis, malignant disease or syphilis.

Tubercular ulceration occurs only as secondary to a pulmonary deposit and examination of the discharge would show characteristic bacilli.

In malignant disease glandular enlargement is a late development, and the progress of the disease is liable to be accompanied by profuse epistaxes.

In syphilis the chancre is followed shortly by characteristic secondary symptoms.

Case Report.

History.—On October 19, 1905, a surgeon in perfect health circumcised a patient on whose prepuce was a large indurated chancre.

On December 16, nearly two months later, he first noticed stuffiness of the right nostril, right-sided headache from brow across vertex to occiput. This was accompanied by malaise, anorexia, chilly sensations and constipation, a condition from which he never before had suffered. For a period of two weeks his temperature ranged from 100° to 100 1-5° F. He had worked very hard for a few weeks prior to December 16,

and he attributed his condition to overwork and a grip-like attack. During Christmas week he visited his old home, but the rest did not improve his condition.

Examination.—I first saw him on December 28, 1905. At that time I made the notation "Superficial necrosis of the mucous membrane covering the anterior end of the right inferior turbinated body; the fibrinous membrane when raised, revealed an ulcerating, bleeding surface." Neither suprarenalin 1-1000 nor cocain solution 10 per cent caused any appreciable blanching or shrinking of the turbinated body. Lachrymation was present on the right side and one gland below the angle of the right jaw was enlarged and tender.

The condition resembled fibrinous rhinitis, but it was limited to the inferior turbinated body and there was no ichorous discharge from the nostril. The swelling practically occluded the nostril, which is narrow on account of septal deviation, the result of traumatism in childhood.

The treatment employed was a cleansing alkaline spray followed by sprays of peroxid of hydrogen and lime water.

Course of Disease.—On January 8, 1906, eighty days after the probable inoculation, a macular rash appeared on the abdomen.

Four days later, when I was shown the rash, I made a positive diagnosis of syphilis and was confirmed in this by Dr. Joseph Zeisler and Dr. T. Melville Hardie.

The "lean-ham" macular and papular rash, more marked on his chest and abdomen, covered practically the whole body with the exception of the exposed portions of head and hands. There were papules at the base of the uvula but no soreness or congestion of the fauces and no glandular enlargement or soreness excepting the before-mentioned submaxillary gland. Disappearance of the fibrinous membrane and healing of the ulceration took place under the simple sprays before constitutional symptoms appeared. Coincident with the appearance of the rash the headache ceased and the general feeling of well-being began.

On diagnosis of syphilis being made, inunctions of mercurial ointment, one dram, at bed-time were begun, and after six rubbings all evidences of the disease had disappeared.

1010-34 Washington Street.

XX.

REPORT OF A CASE OF ABSCESS OF THE TEMPORO-SPHENOIDAL LOBE OF AN OTITIC ORIGIN.*

By John J. Kyle, M. D.,

INDIANAPOLIS.

The history of abscess of the brain from chronic middle ear suppuration is quite frequent, and according to Gowers, in 173 cases, 102 were of otitic origin. The percentage of cases of brain abscess, following years after all observable suppuration of the ear has passed away, from a condition of slumbering mastoiditis, would be of particular interest.

The report of the following case is important because it accentuates the necessity for a careful consideration of the history of middle ear disease and its approximate valuation in the diagnosis of acute or chronic brain disease.

Mrs. Mc——, age 36, was brought to St. Vincent's Hospital November 11, 1905, by Dr. Williford of Washington, Indiana, and the following history was given by the husband and Dr. Williford:

No luetic history; married eleven years; no severe sickness during that time; has three children living, all strong and healthy; two children dead, one died of meningitis and the other of uremic poisoning; suffered from an acute inflammation of the right ear nine years ago, followed by a discharge from the ear, which continued for six weeks; no history of any subsequent discharge; recurrent attacks of earache during the winter months; during last three years, each subsequent attack was a little more severe; previous to the last six months, the pain was always in the ear, but since that time the pain has been just above the ear; the pain was constant, at times being a dull ache and at others a severe boring pain.

In April last, the patient suddenly fell with loss of consciousness, followed by a loss of control of the hand and leg of the right side; complete loss of sensation in arm and leg.

***Read before the Middle Section of the American Laryngological, Rhinological and Otological Society.**

This continued for about two weeks, when the patient was able to be about with the assistance of a crutch. The numbness in the arm and leg continued for about two months. For a longer period than a year, the patient has complained of a severe dizziness, with a tendency to fall to the affected side. At times the patient suffered from nausea and vomiting. Following the discharge from the ear, an eczema manifested itself along the right tibia. Upon examination, we found a long scar and two or three hard nodular masses, as though there might have been periostitis at some time. The ulceration on the tibia continued for at least one year. About twelve days before her entrance to St. Vincent's Hospital she became delirious, especially after sleeping. This would continue for quite a while after awakening. Sleep and relief from pain was only secured by the use of large doses of morphin.

When brought to the hospital she was delirious and unable to walk. When I saw the patient she was in great agony, moaning and tossing about the bed. Her speech was incoordinate and unintelligent. Temperature was 97.4. There was no tenderness or swelling discernible over the mastoid; tympanic membrane clear and glistening; light spot normal. The upper lid of the right eye drooped somewhat, with dilation of the pupil and slight convergence. Babinsky's sign was absent; no anesthesia of arms or extremities; optic fundus normal in both eyes.

With the foregoing subjective signs to guide us, the mastoid process was opened. The cortical substance was hard and sclerosed. No discharge was found on opening into the antrum. On exploring the roof of the antrum, the middle cranial fossa was opened without perforating the meninges. The mastoid process was now obliterated as nearly as possible. The whole process was entirely sclerosed with the exception of two small superficial cells the size of a wheat grain. The roof of the antrum and temporal bone in proximity were now removed with a rongeur forcep. A semilunar shaped portion of the temporal bone one-half inch wide, extending forward for one inch, was removed, exposing entirely the meninges. They were found to be of a grayish-blue color, fibrous and tough. The membranes were opened with a pair of scissors. At the site of the opening a pocket was found about the size of an ordinary hen's egg, partially filled with dark blood, pus and broken down brain tissue, indicative of subacute abscess. The broken

down substance was partially curetted away. There was no distinct outline to the abscess. The middle ear and aditus ad antrum were hard and smooth, and in consequence the middle ear was not disturbed. Following the curettement of the broken down brain tissue, the wound was irrigated with a normal salt solution and packed with a strip of iodoform gauze. A profuse discharge of bloody pus followed the removal of the gauze on the following day. Microscopic findings from the abscess, when first opened, showed a pure staphylococcus pyogenes aureus infection.

The discharge which now followed each dressing for five weeks was pure pus, varying from a tablespoonful to a slight tinting of the gauze at the end of the fourth week. At the end of the fifth week the wound in the meninges was allowed to close. The closure of the post-auricular wound was uneventful. The patient was discharged from the hospital at the end of the eighth week. The patient was quite irrational for two weeks after the operation. She complained of severe pain in the temporal region, which necessitated the hypodermic use of codein for two weeks, especially at night. After this the pain gradually subsided and all opiates were dispensed with. On account of the old tibial scar, iodo-neucloid in thirty-grain doses was given from the beginning, with instructions to continue the treatment for an indefinite period. The eye symptoms partially disappeared after seven weeks, when, with the aid of glasses, the patient was able to read satisfactorily. The patient was perfectly rational and in apparently good health at the time of leaving the hospital. In walking, the patient showed a slight incoordination, with an inclination to move to the right side. The husband now reports the wife to be free from any brain irritation and in better physical and mental condition than for a year.

By way of explanation of the paresis, we may say, if there is a crossing of the motor fibres, then from this lesion it would be impossible for the lesion in the right tempora-sphenoidal lobe, or right half of the cerebellum, to produce paralysis, partial or complete, in the right arm or right leg alone, as the motor fibers, when they cross, do so in the lower portion of the medulla. While the motor fibers do so cross in the vast majority of cases established, about 95 per cent of all human beings, from a lesion located as in this case, we would, in consequence, have motor paralysis in the left arm and left leg.

This would be equally true if the abscess extended forward and inward sufficiently to affect the right peduncle. In other words, if in this patient the usual decussation of the motor fibers occurred, the lesion found in the right temporo-sphenoidal lobe and cerebellum would not account for the symptoms present, and we would conclude that a second lesion occurred, presumably in the left internal capsule. This lesion might have been embolic, thrombotic or hemorrhagic, and might well have been only temporary in its effect. Let us attempt for the moment, however, to associate the clinical symptoms presented with the existence only of the lesion of the right side of the brain found at the time of the operation. We know from experience that a very respectable per cent of individuals have no decussation of the motor fibers, but that they take a course from the cerebral hemisphere to the extremities of the same side of the body, instead of crossing to the other side, and it is not beyond reasonable conjecture that in this patient this anatomic condition existed. If this were actually the case, it is not difficult to conceive that pressure from the abscess in the right temporo-sphenoidal and cerebellar region could be sufficient to produce symptoms from the right peduncle and upper pontine regions, causing motor paralysis upon the same side of the body, by reason of the fact that the usual motor decussation was absent. When we consider that the sensory and motor symptoms of right arm and right leg were of a comparatively transient nature, and had practically passed away upon our first examination of the patient, it is more reasonable to assume that the paralytic symptoms were not due to the abscess in the right sphenoidal region, but to an acute hemorrhagic embolic process in the left internal capsule. In other words, we had at one time two lesions, primarily the abscess in the temporo-sphenoidal lobe, and a transient secondary extravasation in the left internal capsule.

XXI.

INDICATIONS AND CONTRAINDICATIONS FOR INTRALARYNGEAL OPERATION IN TUBERCULOSIS OF THE LARYNX, WITH REPORT OF THREE CASES.*

By Cullen F. Welty, M. D.,

ASSISTANT IN CHARGE OF OTOLOGY, SAN FRANCISCO POLYCLINIC, AURAL SURGEON TO THE CITY AND COUNTY HOSPITAL.

Because of the climate of Southern California, a great many people with tuberculosis of the lung make this their permanent home. Others who are not so fortunate come to this climate during the time of the disagreeable weather at their own homes. Because of this fact, the laryngologists of this section have an exceptional opportunity of observing these cases of laryngeal tuberculosis, and it is for this reason that I present this paper at this particular place.

The percentage of laryngeal tuberculosis in lung tuberculosis is estimated very differently by different observers. M. Schaffer, 97 per cent; Lubinsky, 60; Froumel, 40; Morrell MacKenzie, 34; Heinze, 30; Schech, 30; Gaul, 27; Frey, 26; Krieg, 26; Buhl, 16; Willigk, 14. Probably about 33 1-3 per cent would be a fair average. Age, between 20 and 40 years. More male than female. Seldom under 12 years.

It is well to mention at this place the various pathologic lesions that are likely to be found in this class of patients, that demand surgical interference (in order of frequency).

First—Edema of the arytenoids and epiglottis. Second—Thickening and ulceration of the posterior laryngeal wall. Third—Infiltration and ulceration of the false cords. Fourth—Ulceration of the epiglottis. Fifth—Thickening and ulceration of the true cords. Sixth—Granulometa supported by a pedicle should be removed in all cases.

Heryng and Krause are probably the most radical operators in the world, Herying, the most radical of all, operating all cases. Morris Schmidt and Sheck are somewhat less radical than the former. However, they find a few more indications for operation than Hajek.

*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

For convenience I have made a classification that may help somewhat for getting at the various indications for intralaryngeal operation.

Laryngeal Tuberculosis	Primary	All operated.		
	Secondary	Without laryngeal symptoms	Do not operate.	
		With laryngeal symptoms	Active	Operate only to make the patient more comfortable.
			Passive	Operate to cure the patient.

Tuberculosis of the larynx divides itself very naturally into primary and secondary affections. By primary affection we mean that tuberculosis does not exist elsewhere in the individual. These cases are rare and very difficult of diagnosis. Once certain of the diagnosis, the only thing to be thought of is operation. The more radical the operation, the more chance the patient has for complete recovery.

By secondary affection we mean that there is tuberculosis elsewhere in the body, and that this local manifestation of the disease has been brought about in one of three ways (in order of frequency), lymphatics, blood, expired air and mucus.

The secondary affections are further divided into those without laryngeal symptoms and those with laryngeal symptoms. By laryngeal symptoms I mean pain, cough and dyspnea. Pain may be so intense that the patient will not swallow and from necessity will not eat. It does not take long to reason what will naturally follow. Pain usually induced by edema and ulcerations. Cough may be so severe that it continues to add to the already inflamed and thickened mucous membranes. Cough is primarily induced by ulcerations, edema and mucus secretions. Dyspnea may be so severe that it alone threatens life. When it is so marked as this, the only safe procedure is a primary tracheotomy. The cause of the dyspnea will usually subside with the rest that naturally takes place to the

larynx following tracheotomy. Dyspnea is usually induced by edema and infiltrations.

The cases without laryngeal symptoms we do not operate upon, because the local condition is not causing any inconvenience or annoyance. It occasionally happens that individual cases may change their grouping as the disease either progresses or improves. However, there are many cases in this class that recover completely without surgical means.

The cases with laryngeal symptoms are further divided into active and passive. By active I mean that the tubercular process in the lung is more or less active, that the patient has a temperature of more than 100° F., and is losing weight rapidly. By the passive I mean that the tubercular process is more or less quiescent, temperature below 100° F. and only slight loss of weight.

In the active classification the patients are only operated to be made more comfortable. You do not operate to save the life of individuals. However, you can assure them with certainty that they will be more comfortable the balance of their lives. Some of the cases so operated seem to be followed by a more active manifestation of the primary affection. Heryng, Krause and others think this is simply a coincidence, while others, notably among them Hajek, think this is directly caused by the operation. This condition does happen, and we should be prepared for it, as the patients die in a few days. However, most of the cases so operated feel so much better that they entertain hopes of complete recovery. Usually the lung condition goes on the same as before, and the remaining days are free from laryngeal symptoms, which adds very much to the comfort of the individual.

In the passive or the quiescent condition, a great deal may be accomplished by intralaryngeal operations, in fact, they are the cases of selection. In these cases we operate to cure the local condition, and in many instances this is accomplished. By destroying the field of infection the cases may entirely recover. It is assumed that the tuberculosis of the lungs is in a quiescent condition, and by such an operation you place the patient in the best possible condition for complete recovery, because the field of infection has been destroyed. In fact, so much can be said on this particular phase of laryngeal tuberculosis, that chapter upon chapter has been written upon the subject. Pain is very important in this classification and must

be relieved. Cough is more important under this heading than in the preceding, because it is usually induced by the local condition. Should the cough be allowed to continue, the chances of renewed infection are increased.

If dyspnea is present, an intralaryngeal operation should not be attempted, because the added irritation from the operation will so inflame and congest the parts that there is danger of suffocation from laryngeal stenosis. In such cases a primary tracheotomy is always indicated.

A short time ago I noticed an article in one of the special journals recommending intubation in such cases. I only mention this to condemn it.

About four years ago I was fortunate enough to see a case of laryngeal tuberculosis suffering from dyspnea, which was induced by infiltration of the false cords and thickening of the posterior wall.

The thickening of the posterior wall was removed, and the patient was requested to wait for an hour. One-half hour after the operation there was complete stenosis of the larynx. A rapid tracheotomy was necessary to save the life of the individual. This case was so instructive to me that I will never do an intralaryngeal operation if dyspnea is present.

Sometimes, following an operation in this passive group, the patients seem to have a renewed infection with rapid rise of temperature, lose weight rapidly; in fact, all the symptoms of an acute exacerbation of the old lung condition. This lasts for a week or two, and they gradually get back to their former condition. Their improvement is largely dependent upon the condition of the lung, and upon the complete removal of the tubercular process in the larynx. I have not seen any of these patients die for months following.

Partial or complete removal of the larynx for laryngeal tuberculosis I mention simply to condemn, because it is not necessary, and because the mortality of such an operation is of necessity very high, and because the laryngeal disease is only the local manifestation of tuberculosis elsewhere.

You no doubt have noticed, and will probably take exception to, the fact that I have not spoken of the tubercular process of the lung. If you follow this classification of laryngeal tuberculosis you will find that it is unnecessary, and you will be able to recommend different procedures regardless of the lung condition.

I do know that a great deal of good can be accomplished by the proper procedure. I have arrived at these conclusions by personal experience of four years along this line of work. I have operated on thirty or forty cases, comprising eighty or ninety different operations. I have also had the opportunity of observing three times this number of cases, and these observations have led me along the enthusiastic line of which I speak.

Case I.—Male, age 29, undertaker by occupation, married, two healthy children, wife in good health, father mother, two brothers and one sister well and healthy; one brother died of tuberculosis at the age of 25. The patient has been perfectly healthy until two years ago, when he began to lose weight and had a slight cough. This cough has increased to such an extent that he is coughing practically all of the time. During the last year he has lost about 25 pounds, has an occasional night sweat, his temperature does not reach 100° F. On laryngeal examination, I find decided thickening of the posterior wall, which is ulcerated; slight edema of the arytenoids. Removal of the posterior laryngeal wall, cauterized with 80 per cent lactic acid. For the next thirty days there was not so much cough, and apparently he was much improved. Up to this time he remained in San Francisco attending to his work, which necessitated his being out a great deal at night. Six weeks after the first operation he had high fever, night sweats and rapid loss of weight, and a cough that was almost as severe as when he first consulted me. At this time there was decided edema of the arytenoids, which was not interfered with. The patient was sent to the mountains, where he would be in the open air the whole twenty-four hours. Returned in one month somewhat improved, occasional night sweats; was not losing weight, was not gaining; temperature 100° F. The cough seemed to be the only annoying symptom of which he complained. The arytenoids were more edematous than before. I scarified, which gave him relief lasting for ten days. He returned to the city at the end of thirty days in practically the same physical condition that he was in thirty days before. The edema was considerably increased; it was increased to such an extent that I advised a tracheotomy at once. He had considerable dyspnea and almost complete stenosis. He would not submit to operation, so I told him I could not continue to treat him if he would not follow my directions. He died some six or eight months later.

Case II.—Female, age 38, married, three healthy children, husband healthy, her family history negative, poor hygienic surroundings. Healthy until one year ago, then she developed a cough and lost weight rapidly, had night sweats and daily temperature. In about three months was very much improved and gained some weight, did not have night sweats; no temperature. The cough continued and she began to have pain in the larynx. The pain in the larynx has persisted, and in fact has grown more severe in the last month; at times the pain is so severe that she can scarcely swallow. She would like to eat, but will not, because of the intense pain. A decided thickening of the posterior wall, with an ulcerating surface, was found; this was removed the following day and cauterized with 80 per cent lactic acid. The day after the patient began to eat and has had no laryngeal symptoms since. She gained twenty pounds in four weeks, and from appearances is perfectly well.

Case III.—Male, age 42, clerk by occupation, married, no children, never robust, however, was never confined to bed by illness; parents, brothers, sister and wife healthy. About one year ago he had influenza, from which he did not completely recover. It left him emaciated, weak and with a cough. He had daily temperature, night sweats occasionally. About six months after his attack of influenza he began to experience pain in the larynx when he coughed. This pain increased gradually for three months, until he consulted me. He said that it was so painful for him to swallow that he had not swallowed a thing for five days; besides this, he had night sweats, losing weight rapidly. The cough at this time was very persistent and would prostrate him very much because of the pain induced.

Examination.—Half of the epiglottis had been destroyed by the tubercular ulceration, otherwise the larynx was reddened. I told the wife what I found, what I proposed to do, and what would happen. They insisted that I should proceed at once, which I did, removing the ulcerating surface of the epiglottis, which included practically the whole of the epiglottis. cauterized with 80 per cent lactic acid. I then gave the patient two glasses of malted milk, which he drank with a relish. In a few days he was taking semi-solid food; in the course of a week he was taking solid food. He began to have some pain about ten days after the primary operation. On very careful examination

I discovered a few points of granulation tissue in my former field of operation. They were removed, and their surfaces cauterized by lactic acid. The only annoying symptom that this patient had after the primary operation was the accumulation of mucus in or about the larynx. This was relieved by an alkaline spray. The patient lived sixty days from the time of the first operation. So far as his larynx is concerned, he was perfectly free from all laryngeal symptoms, which no doubt contributed much to the comfort of his remaining days.

606 Sutter St.

XXII.

MOUTH-BREATHING IN RELATION TO MENTAL AND MORAL HYGIENE.*

By Ross Allen Harris, M. D.

LOS ANGELES, CAL.

The philosopher-doctor who declared "The first condition of a successful life is to be a good animal," also affirmed "A sick man is a rascal."

In spite of numerous exceptions that test the rule, we not only find but expect to find a sane mind in a sound body, and a mind diseased in some particular, in an unhealthy body.

Of all the elements, oxygen and hydrogen in the form of air and water are absolutely essential to our existence. A man may live for a month or more without food, for three days without water, but not longer than a few minutes without air.

The all-wise Artificer has given us one mouth for the reception of food and drink, but two nostrils for the admission of air. If one nostril be stopped the other stands ready to do the work of two. If both be occluded, the mouth must needs take up a task unnatural and undesirable to itself.

The mucous membrane of the nose is eminently adapted to repel invasion by bacteria. Its cilia sweep them out as a new broom scatters dust. Its secretion will drown or collect and dessicate them. Dust and small foreign bodies are ordered back by the fine sentinel hairs. The inspired air is warmed and filtered.

A dozen micro-organisms are always normally present in the mouth. They may be numbered by millions in filthy mouths.

The saliva—the combined secretion of the various glands opening into the buccal cavity—varies from two to three pints daily. Aside from its mechanical effect in constantly flooding the oral cavity, it possesses undoubted bactericidal properties.

Nature has thus wonderfully provided against infection. Yet given a *locus minoris resistentiae*, a solution of continuity, plus the virulent micro-organism and we have the entity called disease.

***Read before the Western Section of the American Laryngological, Rhinological and Otological Society.**

The mouth-breather inspires dust and microbe-laden air, and dries too rapidly the moisture of the mouth. The immediate result is a turgescence and hypertrophy of the mucous membrane, followed eventually by atrophy. Dr. Henry Green speaks of a man who contracted conjunctivitis from the action of a draft through a keyhole upon his eye. The mouth-breather has a constant draft upon his pharynx, drying and chilling it. In this way contagious disease of every sort may be contracted, not only the catarrhal but the exanthematous.

Campbell reports three cases of iritis in which there was an absolutely negative history of either syphilis or rheumatism, but in all three there was a marked evidence of oral sepsis.

If pneumococci, or tubercle bacilli be absorbed through pathologic openings in the mucous membrane of the mouth, or swallowed in a bolus of mucus, they are carried to the lymph-nodes of the neck or the lungs. The inflammatory reaction of pneumonia or tuberculosis results.

At Portland the declaration was made that not a few of the affections of the heart valves, ordinarily attributed to rheumatism, resemble those produced by septic conditions much more closely than had been imagined. Marshall says that 90 per cent of all compound fractures of the jaw suppurate.

It is in the throat that we find local manifestations of many constitutional diseases, as influenza, diphtheria, varicella, measles, scarlet-fever, smallpox, and here it is that actinomycosis has its native dwelling place.

The causes of mouth-breathing are manifold, adenoid growths in the nasopharynx being the commonest; deflections of the nasal septum; hypertrophy of the turbinate bodies; acute or chronic catarrh; nasal polypi and neoplasms.

The diagnosis of mouth-breathing is not always easy. Of course, the facies of the common victim of adenoids and hypertrophied tonsils is ever characteristic. The drooping jaw, narrow and inactive nostrils, lustreless eyes, the partial ptosis, the crowded teeth are so diagnostic as to scarcely require mention.

But careful scrutiny will discover that many an active, bright-eyed boy or girl breathes habitually with parted lips. These intelligent youths may progress just so far in school, but will then seem to be unable to make further advancement.

The fault is laid to nervousness, to defective eyes or to innate depravity. The nervousness is attended to by drugs containing more or less alcohol; the depravity by nagging or

stupid punishments; the eyes may be fitted with quarter-diopter spherical lenses. All myopia and all astigmatism should be most accurately and constantly corrected, but the average healthy American child should be able to easily overcome one-half a diopter of hyperopia, and this action of a normal accommodation will be all the more wholesome for his future vision.

Should the drugs, the scoldings and the optician have failed to improve our patient, let us examine him as to catching cold easily, snoring, night-restlessness, a dry throat on waking, and finally with the nasal speculum, the laryngoscope or the visual organ in the tip of the index finger.

Is the mouth-breather doomed to a life-long continuance of his habit? Not if the cause be adenoids or hypertrophied tonsils. As the years pass, usually at puberty, these morbid growths will atrophy and practically disappear. Would that the harvest of their sowing might go with them. But the horrid crop remains.

The chronic nasal catarrh, the atrophic rhinitis, the mephitic ozena, the dread suppurative otitis media, or the great white plague have begun or done their fearful work.

As sequelae to these direct physical effects, and following their debility and exhaustion, are exhibited anemia, indigestion, insomnia, constipation, and rheumatism—that happy term covering a mountain range of our ignorances. And these diseases are the prophetic forerunners of neurasthenia, the neuroses and the psychoses. The mouth-breather being out of harmony with his environment, his moral nature is bound to become perverted.

As one in every ten among the school children of our large cities will be found to be a mouth-breather, and one in five will be found to have enlarged cervical glands, we would urge the following remedies:

1. Monthly inspection of all public schools and juvenile institutions by competent physicians.

2. School instruction regarding the causes and results of mouth-breathing, with lessons in the hygiene of the mouth and nose.

3. The urging by physicians of speedy operation whenever this condition is encountered.

The mental and moral effects of the removal of the commonest cause of mouth-breathing was first commented on—not

by a member of the medical profession, but by a layman, Mr. Edward A. Huntington, principal of a special school in Germantown, Pa.

To his instructive list of reported cases I would add these few, to call attention again to the baneful influence of this unfortunate habit upon dispositions and character.

Case I.—Charles W. Age 8. Always a mouth-breather. Catches cold easily. Chronic suppurative otitis media for six years in left ear. Enormous faucial tonsils, almost meeting together in the throat. Large adenoid mass in post-nasal space. Mother says the boy is very nervous and irritable. Cannot keep still in school. Is often kept after school for punishment. The teacher sent home a note saying the boy was always fighting.

The boy is a center of mischievous activity and cannot keep his friends long. Cries and laughs very easily. Is constantly moving hands, feet or tongue.

Operation, double tonsillotomy and adenectomy. Operation for otitis media refused. Patient's improvement in general health and in school was very encouraging for one year, though he suffered much from recurrent sore throat and breathed most of the time with open mouth. This was supposed to be a continuance of the life-long habit, but examination showed both tonsils again enlarged, the left one especially so. This one being removed while acutely inflamed the entire throat became better, though the mouth-breathing continued. The pus from the suppurating ear was examined at this time. It showed only "dead" cells of staphylococcus aureus, no streptococci being present.

The mother tried to bring about a good habit of mouth-breathing by a sort of cloth bridle which bound up the chin with buckle and strap. The device never proving very satisfactory, a strip of court plaster was pasted across the boy's lips on retiring. This effected the purpose indeed, "not wisely, but too well." Hearing strange sounds one night she entered the room where the boy was sleeping and found him writhing in a convulsion, with vomitus pouring from his nostrils. She tore off the plaster as quickly as she could (it isn't easy to remove court plaster, either) and the pillow was deluged with the remains of a hungry boy's supper, together with a quantity of popcorn he had eaten in the evening. The boy might have been drowned by his own stomach but for this timely intervention.

The attempt at mechanical closure of the lips was abandoned, and moral suasion tried while the boy was awake, with a low pillow while sleeping.

Today the boy is a healthy-looking lad who breathes through his nose most of the time. His last deportment card in school was marked "Excellent," and almost every study showed "Good" or "Excellent." He is a manly boy, with ideals high enough to make him a favorite with teachers and playmates. He bids fair to become a useful and healthy American citizen.

Case II.—Helen G. Age 4. For two years it has been my privilege to observe this child who, but for her affliction, might well be termed a degenerate. Is not degeneracy the result of faulty habit and environment, as well as of heredity?

She is a fair-skinned, tow-haired, well-developed daughter of refined and wealthy parents. General health excellent, but always breathes with open mouth. Is sick in bed with a cold or tonsillitis every month or two. Is highly imaginative, and untruthful insomuch that her mother cannot permit her to attend Sunday school, for on her return she will invent the most impossible fictions that a morbid mind could conceive.

Her play with other children invariably ends in woe to her playmates. She is cruel. She says "I like to slap your little girl because I like to hear her cry." She is undutiful. When her mother calls her she refused to answer, remarking, "She doesn't really want me, she is just calling because she doesn't know what else to do." And, "I like to make Mary do things you don't want her to do, so she won't mind you." She is vindictive. When reproved by a neighbor she threw stones at the baby, saying she hoped one of them would kill it. Insolent to passers-by, strangers wonder at her insulting remarks or gestures. Obscene to a degree, she is the horror of every parent in the neighborhood. When she entered school last September the teacher, glad of any excuse to oust her, declared that as she could not write she must be put in the kindergarten. She is as unwelcome there; and altogether the case is a pitiful one. Her father will not entertain the idea of an operation on a child so young for a habit which she will certainly outgrow!

Case III.—Hazel P. Age 11. This very elegant young lady appeared with her mother at the Eye Clinic of the Medical College, U. S. C., for refraction. Her attire was so startling in a free dispensary that its description may be pardoned. The latest coat, a large Gainsborough hat, white kid

gloves, patent-leather shoes, and well-powdered face completed an extraordinary and unattractive picture. The mother said her daughter had always been nervous, had headaches "across her nose," caught cold easily, was irritable and could not study. The family physician thought she would be benefited by wearing glasses.

Nervous she certainly was. All children are naturally far-sighted, but the most painstaking examination of these eyes showed only a trace of hyperopic astigmatism, for which she would accept no correction.

But the crowded and prominent front teeth, the parted lips, the constant sniffling, the high-arched palate, and finally the large adenoid vegetation discovered in the roof of the pharynx, showed the true cause of her nervousness. Transillumination showed both frontal sinuses dull, and this child was only eleven!

I said, "Madam, your child does not need glasses, but she does need an operation," the nature of which was explained to her. "Oh," she replied, "that mouth-breathing is only a habit. She will outgrow that. I have talked to her a great deal about it, and told her how it looked, and she isn't nearly as bad as she was."

Arguments and prophecy were alike unavailing, and the pair departed firmly antagonistic to doctors who always wanted to "operate."

How about the future weal of this child?

Case IV.—Loren S. Age 12. Has always been a mouth-breather. As soon as he recovers from one cold, he catches another. Snores a great deal. Will not keep covers on the bed at night. Irritable. In school his progress was never satisfactory. Loved to tease younger children, especially his brothers and sisters.

Nose was unusually small and ill-developed, even for a mouth-breather. Alae short and flat. Roof of mouth not especially high. Large faucial tonsils and adenoids. Uvula elongated. Operation on these abnormalities was followed by great improvement in demeanor and in school reports. But the mouth-breathing persisted. The court-plaster method of cure was in vogue at the time (it was before the disastrous experience of Case No. I). The mother tried it faithfully. She said she was alarmed one night by the weird, unnatural sounds coming from the boy. She found him tossing, moaning and somewhat cyanotic but still asleep. She took off the

plaster and the boy became quieter. It would seem as if Nature cries out for just so much oxygen and will have it whether by nose or mouth.

Loren has practiced nose-breathing by running a block with closed mouth. Gradually increasing the distance, he has not only overcome his bad habit, but has developed sturdy legs and lungs.

At this writing, two years after operation, this boy, now 14, has just bloomed into a virile manhood. He is first assistant to a busy mechanical engineer, who tells me he is the best man in his employ and will make a successful engineer.

Case V.—Mrs. G. H. D. Age 72. Earache for several nights. Tinnitus aurium constant. Catches cold very easily. Frontal and temporal headaches. Tonsils were removed 62 years ago. Catarrh for many years. Used to cry with earache when a child. Has been treated in every large city from Washington to San Francisco. Great, green, decomposing and foul-smelling crusts partly occlude both nares. Frontal and maxillary sinuses dark on transillumination. The sense of smell has been entirely lost for years. Breath fetid. Watch heard in right ear at eight inches; in left ear at eighteen inches. Both tympanic membranes retracted.

The earache soon subsided under hot irrigation, but no amount of cleansing and stimulating treatment served to do more than alleviate temporarily the nasal symptoms.

This venerable and venerated lady is convinced that she was a mouth-breather during the years of her childhood, and to this she attributes her present condition. Her ozena annoys her no more than it does other people. "Isn't it strange," she said to a friend, "that with all my catarrh there isn't any odor?" With averted head her friend answered that it was. Possessed of ample means, she could choose any hotel in the city for an abiding place, or would be welcome at her only son's palatial home in a distant town. But, self-exiled, she lives alone in a single room, doing light housekeeping over a kerosene lamp-stove.

"It's a very poor arrangement, this dying," she avers. Afraid to die, without comfort or hope, she flits about from house to house, never keeping the same address long, but always attended, wherever she moves, by this fearful "old man of the sea."

DISCUSSION.

Dr. B. F. Church, Los Angeles, congratulated the essayist on the able manner in which he had covered the subject. He was especially interested in the case histories.

Dr. H. L. Wagner, San Francisco:—Mouth-breathing was interesting from anatomic, physiologic and psychologic grounds. He spoke of ethmoidal sinus, the lymphatic vessels and the offertory nerves and the manner in which they made their way through the cranial bones and referred to the work of Rensallers of Danzig. The laity will more willingly consent to operations once they are educated to their value in these conditions. Cited cases in the literature, all men and all drunkards, who after adenoid operations, became raving maniacs, showing close connection between nose, throat and brain.

Dr. A. L. Kelsey, Los Angeles, felt that Dr. Harris' paper should have been presented before general practitioners, since it is the general practitioners who see these cases first, and as the general practitioners are only too apt to hold to the belief that the adenoids nearly always atrophy as the child grows older, such a paper as Dr. Harris' would have rendered valuable aid in disillusioning their minds of such a fallacy. He spoke of three post-adolescent patients all well on in the prime of life, on whom he had operated for adenoids.

Dr. C. F. Welty, San Francisco, spoke of the tonsillar and pharyngeal tissue as the entrance way of infections such as tuberculosis. He cited case of a recent patient, a boy of 14, in whom tonsils had been removed by another practitioner; the operation, however, being followed by suppurative processes. An acute nephritis accompanied the local disturbance, but disappeared as the suppuration ceased.

Dr. E. W. Fleming, Los Angeles, stated that there were patients with adenoids in whom general condition was good, but who were troubled greatly by the mouth-breathing, and with whom it was very hard to get a good response from treatment. These patients are usually children, ages 4 to 10, who possess a decidedly V-shaped and narrow, hard palate. In such patients, even after the removal of the post-nasal obstructions, mouth-breathing may continue. The difficulty in dealing with the hard palate makes brilliant operative results in these cases impossible.

Dr. H. Bert Ellis, Los Angeles:—Referring to the class of

patients mentioned by Dr. Fleming, stated that it was his custom to send all such to a dentist after his own work had been completed.

Dr. Ross Harris, Los Angeles, referred to the saying of Dench, he thought it was, who made the statement "Every cold in a child is due to an adenoid." No child was too young to be operated upon. His paper had not been intended to be technical, but was intended rather to show the disastrous effects of non-interference at the proper time. The importance of early operation in this class of patients cannot be exaggerated.

XXIII.

AN OPERATION FOR THE PAINLESS AND BLOODLESS REMOVAL OF SUBMERGED AND ADULT TONSILS.*

By Francis B. Kellogg, M. D.

LOS ANGELES, CAL.

The procedure which I am about to describe is in reality a modification of Pynchon's galvano-cautery dissection. In the modification, however, the role played by the cautery is less important than in the original.

Indications:—It is especially effective in the removal of the so-called submerged tonsil. It also has obvious advantages in the removal of adult tonsils of any class. It is in the removal of the adult tonsil that troublesome hemorrhage is most often met, and it is a matter of no small moment to be able to practically eliminate this disquieting feature.

The operation is also well adapted to the cases of submerged tonsillar stumps which are not infrequently left after tonsillotomy in children. These stumps do not usually require attention until the child has attained sufficient age to co-operate with the physician; a very essential condition precedent to the operation.

Technique of the Operation:—The tonsils and pillars are first brushed with a 10 per cent solution of cocain to secure superficial anesthesia. A few drops of a mixture of beta-eucaine lactate 12 per cent, and adrenalin 1-1000 equal parts is then drawn into a Pynchon tonsil syringe. The needle is pricked through the membrane of the anterior pillar at its middle point, and a drop of the mixture injected under the membrane.

Care must be taken not to prick through the pillar. If the membrane only is penetrated a bleb will be raised by the injection. This is repeated above and again below to cover the entire pillar. If the prick of the syringe is slightly felt at the first injection, the second and third are not felt, as a result of the first.

The anterior pillar is injected for the reason that it is liable to be touched by the cautery, and is much more sensitive than the tonsil itself.

*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

After injecting the pillar, the needle is plunged into the stroma of the tonsil at different places, and a very little of the mixture injected at each point. Here, too, care must be taken that the point of the needle does not terminate in a crypt from which the anesthetic escapes into the throat. In the latter case it can be seen running out. The tonsil after injection presents a pale, bloodless appearance. Personally I have used a mixture of equal parts adrenalin 1-1000 and cocain 10 per cent, and have never had any constitutional symptoms except in one case, that of an anemic wash-blond of a decidedly neurotic type. In this case the threatened syncope was averted by prompt measures. Since learning of beta-eucaine lactate, however, I would recommend using it in place of cocaine as the safer agent.

The tonsil is now seized with volcellum forceps at the upper third and drawn out of its recess, and at the same time pushed slightly back toward the pharynx to put the attachments to the anterior pillar on the stretch. A galvano-cautery knife at white heat is now entered at the top between the tonsil and the anterior pillar and passed downward, hugging the tonsil, and separating it well from the pillar. The tonsil is then drawn inward and forward and the process repeated on its posterior aspect. At the upper part the cautery dissection is carried deeper, as it is important to completely separate the tonsil from the supratonsillar fossa. In this manner the tonsil is partially enucleated by the cautery. Instead of being a sessile body it is now pedunculated simply being attached to its bed at the base. At this point the cautery is abandoned, and the loosened tonsil drawn into the fenestrum of a Mathieu's tonsillotome, and the enucleation completed.

A Mackenzie tonsillotome would be equally efficacious, and a wire snare would perhaps be better than either. It would still further preclude the possibility of hemorrhage, although it would probably increase the reaction.

I have never seen any tendency to secondary hemorrhage after this operation, and believe it to be effectually prevented by the cautery, while the primary is taken care of by the adrenalin and cautery combined.

I have used this operation upon children as young as ten years of age, and had them come up smiling for the second tonsil a week after the first.

It is the proper treatment for diseased adult tonsils with a tendency to cholesteatomatous accumulations in the crypts.

DISCUSSION.

Dr. W. H. Roberts, Los Angeles, said he never attempted the cautery, but advocated the snare. He thought the snare safer, as the tonsillar artery might be large; used ether as an anesthetic and operated always with the patient in the sitting position.

Dr. W. D. Babcock, Los Angeles, agreed in the use of the snare and thought the cautery unnecessary.

Dr. E. W. Fleming, Los Angeles, thought it difficult under general anesthesia to use the cautery, and that children resent an operation without anesthesia. Referring to Dr. Miller's paper, he considered tonsils as portals of tubercular and other infections, and that when diseased their removal was indicated. Many tonsils were diseased even though they did not seem to be enlarged or prominent.

Dr. C. F. Welty, San Francisco, referred to the rheumatic symptoms from tonsilitis, being additional indications for their removal.

Dr. H. L. Wagner, San Francisco, stated that he had made investigations, while in Wurzberg, of the tonsil and adenoid, both as to their structure and their absorption properties. He believed that they were fetal structures, and as such have no office to perform in after life. He had confirmed the experiments regarding the transmission of colored particles, and said the tonsil is, as it were, a lymph heart. He expected to show at the next State meeting a dog's lung, in the apex of which are colored particles that were absorbed by the tonsils and transmitted to the lung.

Dr. Hill Hastings, Los Angeles, quoted a report of Dr. A. J. Lartigau from the Pathological Department of the Columbia University, who made a study of hyperplasia of the tonsillar tissue, especially in reference to the possibility of tuberculosis infection. Dr. Lartigau's conclusion were: "Primary tuberculosis of adenoids is probably more common than most previous studies show. Sixteen per cent of our series contained tubercle bacilli, 10 per cent with characteristic lesions of tuberculosis. The tubercle bacilli were present in small numbers. The lesions in primary tuberculosis of the adenoid are generally close to the epithelial surface and focal in character. Occasionally they may be found in the deeper parts of the pharyngeal lymphoid tissue. It is probable from

our experience that many later investigations will show primary tuberculosis in 10 per cent or over of the clinic cases."

Dr. H. A. Kiefer, Los Angeles, emphasized that a complete removal of the tonsil is a difficult operation and that a rheumatic history is often found in chronic tonsillitis.

Dr. F. B. Kellogg, Los Angeles, said that there are advantages of an eschar. The cautery causes a sear which most effectively destroys tonsillar tissue that might be left by a cutting or snare operation. The soreness is never more than from the use of a knife, for the cautery only separates the adhesions.

XXIV.

SECTION OF TEMPORAL BONE; TEMPORAL BONE OF CHILD; METAL CAST OF EAR.*

By Hill Hastings, M. D.

LOS ANGELES, CAL.

Dr. Hastings presented the following specimens for inspection and consideration:

1. A section of the temporal bone showing productive osteitis of aditus and antrum.
2. The temporal bone of a child at birth, showing the high position of antrum and exit of the facial nerve.
3. A metal cast of the ear, including the mastoid cells, cochlea and semicircular canals.

The last specimen, he said, was one of many he had made, most of them having been failures, and was almost perfect. He said that he had made the casts after Politzer's method, but found it was necessary to bore a hole in the superior semicircular canal to provide an air vent before pouring in the hot metal through the meatus. Otherwise the labyrinth was not completely filled. The child's temporal bone, he said, showed another point, namely, the mastoid-squamous suture, in which was situated the antrum. He wished particularly to state that it was a misconception to regard the antrum as a part of the mastoid process. It is rather a part of the middle ear, as was shown by the specimen. Furthermore this conception, which was by no means original, he said, is significant in getting a correct idea of inflammatory conditions of the middle ear. The general practitioner is apt to believe that when the "mastoid antrum" is involved in the course of a suppurative otitis, the ear trouble is then dangerous. As a matter of fact, he believed that the antrum, as a part of the middle ear, is inflamed in every case of suppurative otitis media. Its mucous membrane lining is continuous through the short aditus with that of the cavum tympani, and it is quite unreasonable to suppose that a suppurative inflammation of its mucous membrane should stop at an imaginary boundary line between the tympanic cavity and antrum, and that the antral mucous membrane would remain normal.

***Read before the Western Section of the American Laryngological, Rhinological and Otological Society.**

If this fact is generally known, the necessity for an early incision of the drum membrane will be more impressed on the mind of the general practitioner, as the best abortive measure against mastoid involvement.

XXV.

EUSTACHIAN CATHETERIZATION THROUGH THE MOUTH, WITH REPORT OF AN ILLUSTRATIVE CASE.*

By Hugo A. Kiefer, A. B., M. D.

LOS ANGELES, CAL.

Eustachian catheterization via the oral cavity is a method we meet with but very seldom in actual practice. I have met with only a few gentlemen who professed to use it. It is a method not to be recommended for the ordinary run of cases requiring catheterization, as the methods of Kramer, Deleau and others, utilizing the nasal passages as a way of ingress, is much easier of performance and requires less time. But it is too valuable an adjunct to be deserving of the extreme neglect that has been accorded it. We meet with occasional cases in which the methods above named cannot be utilized on account of nasal obstructions, and for such cases it is very fortunate that we have recourse to the method under discussion.

The technique is not difficult, and can easily be acquired by any one skilled in the use of the rhinoscopic mirror. The oro- and naso-pharynx and soft palate should first be anesthetized. The patient then depresses the tongue with an ordinary depressor, the surgeon manipulates the mirror with one hand, and with the other hand inserts the catheter into the orifice of the Eustachian tube, using for this purpose a metal or rubber catheter (I prefer silver), which should be bent in a long curve at the distal end to almost 90 deg. from the shank. Then withdrawing the mirror and laying it aside, he can use that hand for the manipulation of the Politzer air bag, which should be armed with a rounded hard-rubber tip, which will fit in and close, but not wedge in the orifice of the catheter. The principal difficulty lies with patients who cannot relax the palate sufficiently to afford a view of the nasopharynx. This difficulty, when it exists, can usually be overcome by a little training and persistence, and the use of a local anesthetic, though there are some cases in which it seems impossible to accomplish this. The palate retractor may be tried in such cases.

Incidentally it can be said that this method is cleaner and

*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

involves less danger of carrying infective material into the middle ear than when the catheter is carried through the nasal chambers. How often on passing a catheter through a nose apparently well cleansed, and withdrawing it again without forcing air through, may we find a plug of mucus obstructing its lumen.

The following case will illustrate about the class of patients to whom I would, and do, restrict the use of this method:

J. C., aged 38, farm hand, presented himself for treatment of the right ear, which troubled him with "fullness," and "ringing," and "some pain" for two days past. Contracted a cold in the head one week before this, from which he had almost completely recovered. General health good. Has always had difficulty in breathing through the nose. The right tympanic membrane is bulging, transparent, slightly injected at the margins and presents evidence of serous fluid behind it to the level of the umbo. Very little tenderness at the tip of the mastoid; Rinne negative; temperature 99° F. Simple chronic nasopharyngitis, with some evidence of the recent coryza. Both of the middle and inferior turbinates are much enlarged; a cartilaginous and bony spur on the right side of the septum; deflection of the cartilaginous septum to the left.

Repeated attempts at Politzerization failed after the application of adrenalin and cocain to the orifice of the Eustachian tube; catheterization of the tube through either nasal chamber impossible on account of the nasal obstructions. Catheterization through the mouth was tried, after cocainization, with perfect success and the tympanum inflated. This was practiced daily for a period of six days. Thereafter inflation became possible by the Politzer method, which was employed every other day for ten days, the patient making an uneventful recovery.

It may be added that the patient refused absolutely to have any operations on his nose, thereby exposing himself to the necesity of having the same method adopted in case of a recurrence of the middle ear inflammation.

DISCUSSION.

Dr. F. B. Kellogg would like to see the curve of the catheter referred to.

Dr. W. D. Babcock said the same procedure was done at the Manhattan Eye and Ear Hospital some time ago.

Dr. W. H. Roberts said Kyle had an outfit for the same and he saw him use it.

Dr. A. L. Kelsey had catheterized through the opposite nostril.

Dr. H. A. Kiefer closed by acknowledging his indebtedness to Dr. Kyle for the idea he followed out.

XXVI.

DEMONSTRATION OF SEQUESTER OF THE TEMPORAL BONE OBTAINED DURING A MASTOID OPERATION.

By Henry L. Wagner, M. D.

SAN FRANCISCO, CAL.

The history of this case of traumatis mastoiditis is briefly as follows:

A perfectly healthy man, forty years of age, in falling from his wagon struck the back of his head upon the roadway. He bled from the nose, ear and mouth; unconscious for a few hours, intense swelling and pain, principally on the left side of head behind the ear, combined with fever. Patient under treatment by his family physician for some weeks. During this time spontaneous serous discharge from the middle ear, which later became purulent. Two months from time of accident patient came to my observation. He then had regular pulse, no fever, nor pain over mastoid region by pressure, only a very copious purulent discharge from the ear, indicating that the mastoid antrum was apparently the source. Microscopic analysis revealed streptococci. During the extensive mastoid operation, I found the periost very adherent to the bone, indicating a subsided periostitis. The larger part of the mastoid bone was removed from the zygomatic cells, including them, clear to the tip of this bone, disclosing a pneumatic structure and this sequester was found in its petrous portion. In removing the sequester both of its ends were broken off; it now measures two centimeter in length and one in width, and it was at least a centimeter longer before being broken. Whether this sequester had been formed by the process of streptococcic osteomyelitis, or by fracture, or by both, is difficult to say. The patient made a slow but uneventful recovery. Directly after the operation not the slightest trace of pus was observed to come from the middle ear.

XXVII.

A NEW TONSILLOTOME.

By Edwin Pynchon, M. D.,

CHICAGO.

PROF. RHINO-LARYNGOLOGY AND OTOLOGY, CHICAGO EYE, EAR, NOSE AND THROAT COLLEGE.

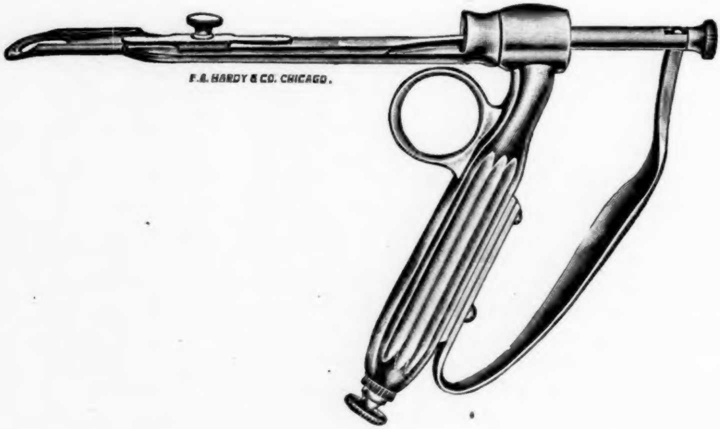
At the meeting of the American Academy of Ophthalmology and Oto-Laryngology, at Denver, Aug. 24-26, 1904, I exhibited a tonsillotome, the handle of which was a continuation of the shaft of the instrument and the blade of which was spring actuated so as to automatically remain back of the fenestra. It was illustrated and described in the Dec., 1904, issue of *The Laryngoscope.*

As a result of further experiment I have changed the instrument so the handle is at less than a right angle to the shaft of the blade. In this way more pressure can be applied in its use, than when placed at the usual angle which is, to an equal degree, more than a right angle. The ring through which the index finger is placed improves the grasp and also serves as an auxiliary handle when adjusting the mouth-gag etc. In order to retain the advantage of the spring actuated handle I have employed a spring quite like the spring of a grapevine shears. In this way it can be used equally well in either hand by one who is not ambidextrous, while in the position shown in cut, if desired, the blade can be revolved so its concavity will be in the opposite direction, by pulling down the button which is at the lower end of the handle, whereby the blade is unlocked, so it can be revolved at will, there being a stop notch on either side. This combination of spring and handle gives to the hand the maximum degree of cutting power.

I retain the form of blade, curved on the flat, which I have previously used in both a Mathieu and an Ermold tonsillotome, whereby the cut conforms to the normal curve of the faucial side walls. With this instrument a tenaculum forceps should be used to pull the tonsil well through the D-shaped fenestrum,

the proximal side of which is made without curve, so as to materially increase its area. The straight edge furthermore conforms to the line of the posterior edge of the anterior pillar, and is therefore better than if curved.

I have as yet had made only one size of this instrument, the fenestrum of which is 1x5/8 inch, which is too large for a small child though large enough for the largest tonsil which I care to remove with a tonsillotome. In all cases, before use,



it is desirable to first sever any attachments which may exist between the tonsil and either pillar. If this is thoroughly done a very large tonsil can be easily pulled through the fenestrum.

By removing the nut at the spring contact end of blade shaft and unlocking the revolving lock, the entire cutting portion can be quickly removed from the handle for sterilization. This tonsillotome has been perfected for me by F. A. Hardy & Co.

Columbus Memorial Bldg.

XXVIII.

NASAL OBSTRUCTION A CAUSE OF DEAFNESS.

By D. H. Trowbridge, M. D.

FRESNO, CAL.

I have, for several years, been endeavoring to settle in my own mind, the real importance of nasal obstruction as a causative factor of middle ear catarrh, and after observing a great many cases of this character, I am fully convinced that the obstruction of the nares is responsible for a great deal more disease of the middle ear than it has been given credit for in the past.

In looking over several text books on the disease of the ear, I was unable, in some, to find any reference to the nares and their relation to the ears, and in others, very little space was devoted to the subject. In all, however, there was a liberal space allowance given to the pharyngeal vault and the influence of its disease and growths on the hearing; so that one would suppose that the anterior and middle nasal region had but little to do in influencing the proper functioning of the ears.

I think that you will all agree with me that in examining cases of deafness in general, we find in a very great percentage of them, a decided change in the nose from the normal. In a few cases of deafness we find an atrophic rhinitis, and in such cases we are apt to have an atrophic change in the middle ear as well. But in by far the majority of the cases of middle ear catarrh that have come under my observation, it has been my experience to find obstructive changes in the nostrils.

We are all perfectly familiar with the decided effect which adenoid vegetations in the pharyngeal vault have upon the hearing, especially in children and in young people. We are every day finding cases of this kind where the patient is almost entirely deaf, and after removing the adenoid growth thoroughly, we find in a few days that our patient has perfect hearing. Now, if the enlarged third tonsil can be the agency in produc-

ing such a decided influence on the middle ear, it seems only reasonable to suppose that an enlarged and tumified middle or lower turbinate, which is just as near the orifice of the Eustachian tube, and is of the same continuous mucous membrane, should produce just as decided an effect.

Again, we are all accustomed to have a patient suffering from an acute cold, with inflammation of the membranes lining the nasal cavities, come to us with decided reduction of hearing, which is entirely relieved as soon as the acute cold and congestion in the nose is cured.

Reasoning from the above, it seems to me that the only natural conclusion to draw is, that where we find a patient who is suffering from chronically obstructed nostrils, either by enlarged turbinates or deformed septum, he is in danger of a chronic effect on the middle ear, just as an acute obstruction will produce temporary deafness. I make it a rule to examine the nostrils, as well as the pharyngeal vault, in every case of deafness that comes to me. And during the past several years, I have commenced the treatment of a number of these cases of deafness by operating on the nostrils to obtain a thorough ventilation of the nostrils. Of course this was after ascertaining that there was no obstruction in the vault of the pharynx. If there was a septal spur, I removed it. If the obstruction was due to hypertrophied turbinates, either middle or lower, I did a turbinectomy and this on one or both sides, as the anatomy of the nostrils demanded, to procure a good, free and open nostril on both sides.

In many of these cases I have been gratified to find decided improvement in the hearing after from two to four weeks. In cases where the deafness had not been of too long standing, or too severe a degree, the hearing became normal; in others it improved to some extent, and in still others of a more deeply seated character, I obtained little or no improvement in the hearing. Many of these cases that had been brought to find relief, came on account of the tinnitus, which is often the first symptom of which the patient complains, even before he realizes that he is becoming deaf at all. In some of these cases the tinnitus had entirely disappeared, and in a considerable number it was relieved to a large extent. In addition, in nearly all cases, the patient feels the relief obtained by being made to have free nasal respiration.

The results mentioned above were obtained in these cases

without any other treatment. Of course, I do not believe every case of deafness will be cured, or even helped, by the above method of treatment. Only in cases where the changes in the middle ear are not too far advanced, can we expect to obtain any benefit in the hearing. However, by the relief of the nasal obstruction, we can do much toward staying the progress of the disease, even if it is not very decidedly helped, and this is of no mean value to a patient who is becoming slowly but surely deaf.

It is a fact that is not entirely clear to me, that the deafness caused by an enlarged third tonsil is quickly cured by removing the cause, while middle ear changes, caused by other nasal obstructions of more permanent character, are more persistent and constant and much more likely to remain permanent. However, I have had such good results in many cases following the thorough removal of nasal obstructive process that I can not but feel certain that it is a very decided factor in the causation of deafness. Therefore, it seems to me it is most necessary as a prophylactic measure if for nothing else, that we make it a rule to point out to our patients the need of obtaining and maintaining free nasal respiration as a preventative of possible future deafness, even where it has not already caused middle ear changes.

A few words on my own method of operating on these cases may not be amiss. I have, in recent years, almost entirely discarded the electro cautery on account of its limited power to remove tissue, and also on account of the severe reaction which follows its use. In past years when I frequently made use of the cautery, I was many times chagrined to find in a few days that my patient had a suppurating ear, which I felt was entirely due to the reaction of the cautery. Since discarding it, I have never had that unpleasant result, except once, and that in a case where excessive hemorrhage required a secondary plugging of the nose for several days. Then again, the cautery will not remove any of the bony formation. Hence, if a bony spur or an enlarged turbinate is to be removed, it certainly is inadequate. My preference is for the trephine drill, operated by a motor which does not revolve too rapidly. With this I drill out nearly all of the bone, which I desire to remove, and the remaining soft tissue can easily be snipped off with a Pynchon's or Hartman's fenestrated nasal forceps.

My aim in these cases is to produce a large, free, open nos-

tril, and if we stop short of this we are apt not to obtain results. My experience has been that if I err, it is in not removing enough structure and that when the nostril is healed, that I have a nostril that is smaller than I wanted, rather than too large. I never remember finding after operating that I had a nostril that was too roomy, but on the contrary many times where I thought I had removed enough tissue, when the membrane was entirely healed, I found I had removed too little. I think there should be from one-eighth to one-fourth-inch space between the outer wall and the septum.

I do not for a moment think that old chronic cases of middle ear catarrh can be cured, or very much relieved, by the above method. Where once the condition is long established, it is one of the most baffling of the diseases we are called upon to treat. To cure, or materially improve middle ear catarrh, it is necessary to begin our treatment before the changes in the middle ear are advanced beyond the first stage. I think in cases of nasal obstruction in which the middle ear disease has not been of too long standing that we can expect much from a thorough removal of the obstruction.

Do not understand me as advocating this treatment as being sufficient in itself. Of course I make use of the ordinary methods of treatment and only advocate this as preparatory, as it were, on certain select cases which apply to us for relief.

With your permission I will report just a few cases:

Case 1.—Mr. B. consulted me on account of deafness of left ear. Test: Hearing watch R.—72/72 L.—24/72. He also complained of some tinnitus, and as he was a cornet player he complained of a peculiar, unnatural resonance in the ear when making certain notes. I found decided nasal obstruction on both sides, but most decided in the left nostril. This was removed, and by the time the wound was healed, his hearing was almost normal, even before the right nostril was operated upon. He still retains improvement under occasional inflations.

Case 2.—Miss P., a teacher, was referred to me by Dr. Flemming on account of deafness of two or three years' standing. Both lower turbinates were prominent. I advised operation, and removed both lower turbinates at different sittings. Her tinnitus has disapeared, and although I have not seen her recently, her physician reports her much improved in hearing, and very much pleased.

Case 3.—Mrs. B., consulted me on account of a chronic middle ear catarrh of several years' standing. Her hearing was considerably reduced, being for the watch R.—43/72 L.—3/72. On account of the chronic condition and the length of time she had been suffering, I did not give her much encouragement. I explained her case to her, and told her we could only try, and promised her nothing. I operated on the left nostril, which was not as decidedly obstructed as many cases I have examined. After the nostril was entirely healed, with the aid of a few inflations, I found her hearing considerably improved for the voice, and for the watch she heard 60/72 in right and 15/72 in left. Being an improvement of 12/72 with right, and 15/72 with left. This was really better than I had expected in thise case, on account of the length of time she had been suffering.

I could report other cases of like character, so that I can but feel that in treating middle ear cases without giving due attention to the nostrils, we are neglecting a most important part of our treatment.

DISCUSSION.

Dr. E. W. Fleming, Los Angeles: As he understood the paper, Dr. Trowbridge advocated nasal treatment for deafness more as a preventative than as a cure. To this Dr. Fleming agreed. He did not believe that operations for well established middle ear conditions would be of much avail. If operation procedures are advocated in these cases, they should be urged because of rhinologic reasons. If nasal obstruction did not exist, operation was not indicated. In cases of recent ear deafness, ventilation of the tube and ear could be improved by clearing nose of obstructions, but as a routine measure for well marked chronic catarrhal inflammation of the middle ear, he had not had much success by such procedure. Where there was posterior hypertrophy of the middle turbinate, then removal of posterior hypertrophy led quite frequently to improvement, so far as head noises were concerned.

Dr. C. F. Welty, San Francisco: To get at the bottom of this problem of obstruction, it was necessary to determine, first, what was to be done, and second, how was it to be done. Deafness could be classified as of three kinds, and two of these forms, viz., labyrinthine affections and oto-sclerosis, would give no response to nasal treatment. Where, however, an adhesion or catarrhal process with organized exudate binding down

the small bones was found, there a response, and an immediate one at that (forty-eight hours) might be expected to show itself. A contributing cause to deafness, be it an hypertrophy or a deformed septum was always to be removed. Prefers scissors and knives to cautery in this class of operations.

Dr. R. W. Miller, Los Angeles, took it that Trowbridge's cases mere mostly children, afflicted with catarrhal deafness. Dr. Miller believed in conservatism in nasal operative surgery, for too often too great a removal of tissue leads to subsequent atrophy and loss of function of nasal tissue. A good rule would be never to destroy so much of the turbinates, that in acute rhinitis there would be an absence of contact and pressure.

Dr. D. H. Trowbridge, San Franciso: In closing the discussion, stated that it might be unwise to remove too much nasal tissue, but he had never seen a patient where such had been the case. As a rule, too little is removed.

XXIX.

THE MORPHOLOGY AND EMBRYOLOGY OF THE NASAL FOSSAE OF VERTEBRATES.

By Leon Dieulafe,

Translated by Hanau W. Loeb.

(Continued from the March Annals.)

Mammals.

In all the series of mammals, the general plan of the structure of the nasal apparatus is almost the same, the variations being in the dimensions of the nasal cavity, the disposition of its orifices and turbinals and the amplitude of the sinuses.

Nasal Cavity.—The usual shape of the nasal cavity is that of a quadrangular pyramid, with a base posterior and apex anterior. The turbinals modify the shape of the walls and lessen the lumen. The length of the cavity is generally proportionate to the length of the head and particularly to the length of the snout. The influence of the alimentary regimen is a large factor in these variations, while the height and size are dependent upon the extension of the respiratory apparatus.

External Orifice.—The anterior or external orifice is surrounded by a system of cartilages covered by skin, which forms the naris; to this, muscles are often attached. The musculature is often well developed and Wiedersheim (1890) reports the existence of sphincters and special valves in diving mammals. The orifices are often situated behind the end of the snout (Quadrumana), just at the end of the snout itself (Carnivora, Rodentia, etc.); sometimes they are prolonged into a tube, in which case a cartilaginous canal lies anterior to the nasal bones and articulates with them. This is the case in animals with projecting snouts (bears, moles). The snout of the pig is a rigid tube surrounded by circular fibres. Sometimes the nasal orifices end in a single tube of long dimensions, as the trunk of an elephant. The orifices may lie on the dorsal surfaces of the head (the blow holes of the cetaceans). The cartilaginous skeleton which surrounds them may be incomplete, as in the nose of the solipeds and ruminants. Finally the external orifice

may have rigid borders, as in Ornithorhynchus, in which it perforates the superior surface of the horny box which supports the maxillary.

Blow Hole of the Cetaceans.—There are certain whales which, on account of the single blow hole, are considered as monorrhinal. In reality, the blow hole leads into a chamber (spiracular cavity) in which the two nares end. Some valves (valves of v. Baer) separate the spiracular cavity from the nares. These cavities send diverticula in various directions (spiracular sacs and nasal sacs). The nares are provided with dilator muscles, retractors of the nasal alae and constrictors of the nose. In the sperm whale the nasal region is specially affected by the asymmetry of the cranium. The blow hole is to the side of the median line. The left naris has normal dimensions, the right is large, but it ends in a true nasal cavity (Pouchet and Beauregard, 1885). According to Pouchet (1889), the symmetrical position of the blow hole of cetodonts may be explained on the supposition that the latter is formed by the naris of the corresponding side (left in the sperm whale) into which, by special embryogenetic process, the nasal cavity of the opposite side opens. He noted in an embryo of the sperm whale, that the right naris was obliterated by epithelium, and the communication between the two cavities effected through the agency of the epithelial expansions, originating from the nares themselves and giving origin in a general way to the sacs of the blow hole.

Kükenthal found the nares fused together, forming a vestibule, in embryos of the dolphin.

Abel (1902) attributed to the position of the nasal fossa the cause of the cranial asymmetry in the odontocetes, but according to this author, this does not depend upon a superficial asymmetry, because the external nares, which are found in the skin, remain in the median line in the animals which he has studied. The deformity is in the bony system. The asymmetry of the cranium is greater in the varieties where the nares are placed higher up (Platanistidae, Ziphiinae); on the contrary, when the nares are placed more anteriorly, the bilateral symmetry hardly deviates (Zeuglodon, Phocaena, Neomeris, Cyrtodelphis); on the other hand, in young animals in which the nares are found much in advance of the cranium, the asymmetry is very slight or nil. The recession of the nares allows the animal to breathe when only a small portion of the head

is outside of the water. The principal bony modifications are in the nasal and interparietal bones, which become rudimentary.

CHOANAE.—The posterior orifices or choanae end in the pharynx behind the soft palate. The air which goes through the nasal cavity passes through the pharynx before reaching the larynx. In certain cases the air enters directly into the larynx, when it occupies a very high position and ascends just behind the soft palate (solipeds). The opening of the choanae is placed sometimes in a vertical plane (monotremes, marsupials, proboscidians and primates), and sometimes in an oblique plane (carnivora, ruminants, solipedes). The two pterygoid processes limit a sort of fossa, very variable in its extent, into which the two choanae open.

NASO-PALATINE CANAL.—We find not only an incomplete palatal vault, as in birds, but also a communication persisting between the nasal and the buccal cavities in their anterior region. This is the canal of Stenson, incisor foramen or naso-palatine canal. It was discovered by Stenson and described by Bartholin, Verheyen and Santorini. It is not patent in all mammals. Lieutaud, Bertin, Heister, Holler, Portal, Boyer and Scarpa claim that it is impossible to enter the mouth from the nasal cavity through this canal, especially in man, in whom it is most atrophied. Jacobson and Cuvier are in accord with this opinion. According to Rosenthal, Weber, Huschke and Arnold, it is normally perforated. Leboucq (1881) has observed in several human fetuses (4th and 5th month), that the canal was precociously obliterated by the accumulation of an epithelial mass. The palatal papilla, which Merkel considers as a sensory organ, is placed between these two orifices or their remains in man.

SKELETON.—The internal wall is a septum formed by the vomer, a cartilaginous lamina and the vertical plate of the ethmoid. The inferior wall, slightly concave transversely, is composed of the palatal laminae of the superior maxillary and of the palate and a process of the intermaxillary. The roof or superior wall is formed by the nasal, the nasal spine of the frontal, the cribriform lamina of the ethmoid and the body of the sphenoid. The intermaxillary, the superior maxillary, the lachrymal, the lateral mass of the ethmoid and the vertical lamina of the palate constitute the external wall:

The osteology has been studied, with much detail, in the

works on human anatomy, comparative osteology and monographs on certain mammals (dog, cat and rabbit), so that we need not give, as in the preceding groups, a special description of each bone of the nasal framework. We will give details only of the arrangement of the bones. In the monotremes (Ornithorhynchus and Echidna) it is difficult to distinguish the sutures between the different bones of the cranium and the face. The facial wall is elongated, and in the Ornithorhynchus the superior maxillaries support a horny box.

The marsupials have nasal bones which are larger behind than in front, of which the anterior border is free and the external border articulates with the intermaxillary. The superior maxillary is very long and the posterior third of its inferior border is provided with tooth sockets. The palatal laminae of the palate bones are very extensive.

The cetaceans have bones which are very great in volume, the maxillary and intermaxillary being very large longitudinally. They have been studied by Abel (1902) in the Eurhinodelphis (dolphins of the upper Miocene). These animals possess a double orifice (foramen olfactorium) for the passage of the olfactory nerve, while the nerves no longer exist in the true delphinides.

In Edentata (ant-eater), the bones of the face have an excessive length, constituting a true cylindrical beak, which is flattened on its inferior surface. The nasal fossae have the form of funnels; the nasal bones, which are very long, are narrowed towards their posterior part so as to pass between the anterior spine of the frontal and the superior maxillary, their anterior extremities reaching that of the superior maxillary. The palatal lamina of the palate bones are very large. The pterygoids aid, posteriorly, in forming the nasal floor. Anteriorly, the nasal cavities are separated by the vomer; posteriorly they communicate extensively with one another.

The nasal bones of the Insectivora (hedgehog) are only narrow bony bands, hardly perceptible. On the other hand, the intermaxillary are very well developed in size and form a part of the nasal roof. The nasal bone articulates with the internal border of the intermaxillary throughout the whole of its anterior extremity. The palate bones are joined with the superior maxillaries without distinct limits. The pachyderms have massive bones. In the tapir, the intermaxillaries are joined together in the median line; posteriorly they do not

reach the nasal bone. The internal or superior border of the maxillary ascends posteriorly and articulates with the descending process of the nasal. The intermaxillaries take only a very restricted part in the formation of the palatal vault. The nasal bone, large posteriorly, becomes thin anteriorly; the process which articulates with the maxillary passes from the posterior part of the external border. It is directed downward, then forward, forming a sort of prop which supports the nasal roof.

Among the probiscidians, the hippopotamus has very long nasal fossae, in conformity with the head. The anterior orifices are bordered by the lateral masses appertaining to the intermaxillary, which are not distinctly separated from the maxillaries in these animals. The nasal bones have a quadrilateral form; posteriorly it is difficult to distingush them from the frontal.

In the elephant the intermaxillary is very large and very long. Its body is well developed and carries the anterior nasal orifice towards the middle of the face. The two anterior nasal orifices end in a large excavation which overhangs a median pyramidal ridge belonging to the nasal bones, which fuse completely with the frontal. At the bottom of this antrum, the vomer separates the two nasal fossae. The external wall is formed only by a thin bony lamella, external to which a large hollow cavity is found in the superior maxillary. Towards the middle portion of the cavity, the external surface is convex and the lumen narrowed. The floor of the nasal fossae is very narrow compared to the dimensions of the head.

In the solipedes (horse and ass) the intermaxillary does not reach the frontal. It reaches the external border of the nasal bone at the union of the anterior with the middle third.

The intermaxillary of the ruminants stops at the superior border of the maxillary without reaching the nasal junction, in which case it has the same disposition as in that of the solipedes.

Among the rodents the guinea-pig has very large nasal bones, which are in contact with the intermaxillaries throughout their external border. They lie between the nasal and the superior maxillary as far as the frontal.

In the bear (Carnivora) the nasal bones are long, and the intermaxillary passes backward to the frontal. The primates resemble man so much that there is little difference from an

osteologic point of view. The intermaxillaries are very distinct, as in other mammals, while in man they are completely fused with the superior maxillary. The nasal bones of the monkey are solidly united to one another and almost fused.

In man the internal wall or nasal septum, formed by the vomer, the perpendicular lamina of the ethmoid and the cartilage of the septum, does not always divide the nasal fossae into two equal cavities. It is often asymmetrical and inclined to the right or left. The septum is always symmetrical in the first years of life. In the adult, on the contrary, it is asymmetrical in more than half the cases. Cloquet expresses the opinion that the curvature depends upon a primitive law of organization. This deviation seems to us to be due to the asymmetry of the face, which may be considered normal and which is found in the most beautiful faces. Exaggerated, annoying deviations may be produced by inflammation of the mucosa, under the influence of which the physiologic curve of the subjacent cartilage is accentuated.

LUMEN OF THE NASAL CAVITY.—Ridges encumber, modify and complicate its form in various ways. These ridges, the turbinals, are inserted, on the external wall, and on the ethmoid. Between their bases of insertion are spaces in the form of fossae, known as the meatuses. Between the free border of the turbinals and the septum the lumen is more or less narrow, forming an irregular canal, dilated in its middle part and narrowed at its extremity. In viewing a transverse section of the nasal fossae, made at the region of their greatest vertical height (Fig. 20), one becomes immediately impressed with the reciprocal relations which exist between the respiratory and olfactory portions. The superior part of the lateral wall, in man, is so close to the nasal septum that there is only a narrow cleft between them. The mucosa which covers this region has a structure and appearance different from that covering other points of the cavity, and we shall study this under the name of the olfactory mucosa. The subjacent respiratory passageway, enlarged at the level of the meatuses and narrowed at the level of the turbinals, is separated, in man, according to Meyer (1885), from the olfactory cleft by the free border of the middle turbinal, which corresponds to a slight swelling of the nasal septum.

Nasal catarrh may easily cause an almost complete obliteration of this narrow hiatus, and one may therefore understand how this affection may occasion frequent interference with the perception of odors.

The nasal fossae of quadrupeds are not separated into two but into three cavities, because of the tremendous development and horizontal position of the terminal lamina of the ethmoid. They are the anterior, which encloses the inferior turbinal, the posterior, situated between the floor of the nose and the ter-

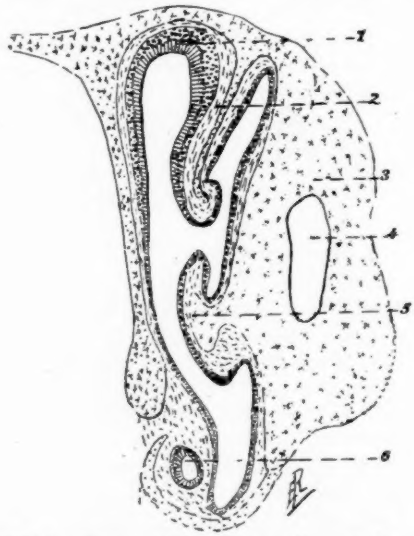


Fig. 20—X 34.3. Mouse (transverse section of the nasal cavity comprising the organ of Jacobson and showing the olfactory and respiratory regions). 1. Olfactory epithelium; 2. Ethmo-turbinal; 3. Superior maxillary; 4. Maxillary sinus; 5. Maxillo-turbinal; 6. Organ of Jacobson.

minal plate (nasopharyngeal canal of Dursy), and the superior, placed above the preceding and containing the olfactory margins (Zuckerkandl).

Into the meatuses open the accessory cavities, true expansions of the nasal mucosa into the facial bones. In certain cases, in which one of these cavities, the frontal sinus or the maxillary sinus, is found open by some accident, it may be shown that the mucosa which covers it transmits no olfactory impression. These sinuses, therefore, should occupy a special

relation to the respiratory passageway. With the exception of the sphenoidal sinus and the posterior ethmoidal cells which open into the olfactory region (superior meatus and olfactory or ethmoidal fossa), all the other cavities, especially the most important (frontal sinus, maxillary sinus and anterior ethmoidal cells), open into the middle meatus below the middle turbinal.

Before undertaking the study of the nasal mucosa we shall study the ridges and the anfractuosities which they cover: 1, turbinals; 2, sinuses.

TURBINAL APPARATUS.—We may distinguish three turbinals in man: inferior, middle and superior. This division cannot be equally applied to all mammals. It is therefore preferable to differentiate the turbinals after the terminology of Schwalbe, Zuckerkandl, Seydel and Killian, into maxillo-turbinal[1], naso-turbinal and ethmo-turbinals.

The baso-turbinal of Schönemann is classed with the ethmo-turbinals.

MAXILLO-TURBINAL (Inferior turbinal, concha maxillaris). —This is a ridge, elongated antero-posteriorly, inserted upon the nasal surface of the superior maxillary. The lamina of insertion is directed towards the interior of the nasal cavity, and there it rolls up or branches, its form often becoming very complicated. Harwood distinguished two principal forms: twisted turbinals (Herbivora) and branching turbinals (Carnivora). Zuckerkandl (1887) divides the various forms of inferior turbinals of mammals into two types: coiled turbinals and branched turbinals. The coiled turbinals may present a one or two coiled laminae; in the latter case there is a superior and an inferior. The coiled turbinal always leaves a certain space between its free surface and the septum; the branched turbinal may completely obstruct the nasal lumen.

The monotremes studied by Zuckerkandl (Echidna and Ornithorynchus) present differences in the disposition of the inferior turbinals. In Echidna aculeata typica, the inferior turbinal is an elongated projection which has two grooves upon its free surface; there is hardly a trace of rolling.

In an Echidna of undetermined species, two lamellae extended from the lamella of origin, one directed downwards and one directed upwards. The grooves placed upon the free

(1) Turbinal comes from turbo, turbinis, meaning rotation.

border of these lamellae are doubled by secondary lamellae, which is the beginning of a ramification. In Ornithorhynchus paradoxus, the surface of the turbinal is divided into 17 lamellae; here the secondary lamellae are branched into tertiary lamellae and these latter are rolled up at their extremities.

According to Allen and Otto Grosser (1902), the Cheiroptera of the Insectivora have an inferior turbinal in the form of a long band. We have studied the badger, which has a very well-developed inferior turbinal. Its pedicle is long and thin.

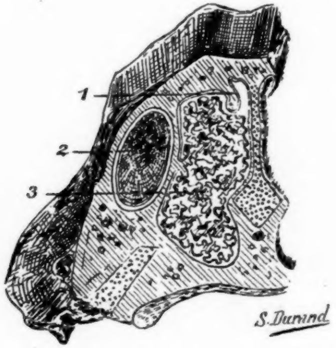


Fig. 21. Twice natural size. Badger (transverse section, showing spongy network formed by the ramifications of the maxilloturbinal). 1. Naso-turbinal; 2. Maxillary sinus; 3. Maxillo-turbinal.

Upon its middle portion, and upon an extent equivalent to one-half of its length, it supports a large round mass, convex upon its superior, inferior and external surfaces, flattened upon its internal surfaces and cut into a very large number of lamellae extending antero-posteriorly.

We have here a beautiful type of branched turbinal. In a very interesting transverse section (Fig. 21) we may see that it fills up the nasal cavity, which is very spacious. The lamellae, which are irregularly branched a great number of times, include between them some spaces, areolar in appearance, which

give to the inferior turbinal a sponge-like aspect. The respiratory air is absolutely obliged to pass through this meshwork. Similarly the inferior turbinal in the elephant is cut up into numerous vertical lamellae.

In the ruminants there are two coiled laminae, as in the pachyderms. In the sheep the antero-posterior extent of the turbinals is very large. The middle region forms a strong prominence which is flattened laterally, very high, and is

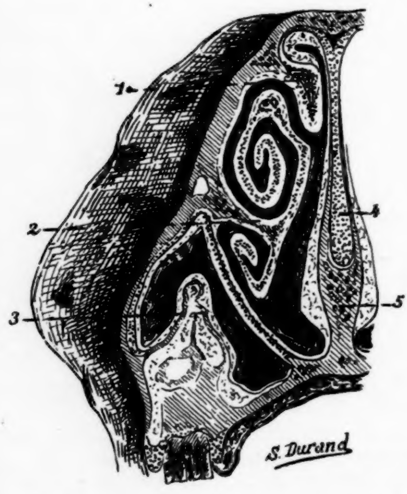


Fig. 22. Six-sevenths natural size. Sheep (transverse section showing double rolling of the maxillary turbinal). 1. Naso-turbinal; 2. Maxillo-turbinal; 3. Maxillary sinus; 4. Cartilaginous septum; 5. Vomer.

composed of two parts, one situated above, the other below the lamina of origin. In the transverse section (Fig. 22) it may be easily seen that each of these parts is a coiled lamina, the upper one describing about a turn and a half, the inferior one complete turn. The solipeds (horse and ass) have a very voluminous inferior turbinal, but it has only a single coil.

In the rodents (rat and guinea pig) the anterior extremity

of the turbinal reaches the level of the nares. There is only one roll, directed upwards.

The inferior turbinal is very complicated in the Carnivora (seal, otter, beaver), according to Cuvier. It is cut up into multiple lamellae in the dog; in the cat the turbinal is extended obliquely backward and downward. Its middle portion is voluminous and almost cylindrical, and is cut up into lamellae by antero-posterior grooves.

The same disposition is found in the tiger. In a large number of monkeys, the inferior turbinal is a ridge more or less prominent, rounded vertically, voluminous in its middle part (Cercopithicus). In the gibbons and cebus there are two rolls. In man it is a thin, curved lamina, slightly rolled, having a body and three processes (Henle). The anterior or lachrymal process serves to limit the osseous lachrymal canal; another, the posterior or the processus ethmoidalis, is articulated in several places with the uncinate process of the ethmoid; the third, or processus unciformis, is directed downward opposite to the two others. (See Zuckerkandl, *Anat. Foss. Nasal.* Pl. IV., Fig. 2.)

Naso-turbinal (Middle turbinal of certain mammals, anterior turbinal of Schwalbe, agger nasi of man, first ethmo-turbinal of the writers).—This turbinal is placed above the maxillo-turbinal, inserted upon the external portion, partly in the ethmoid region and partly in that of the superior maxillary. Zuckerkandl (1895) describes in it a free portion in the cavity (pars libera), and a posterior portion covering the ethmoidal turbinals (pars tecta).

In certain mammals (rodents) its situation places a middle turbinal between the maxillo-turbinals and the ethmo-turbinals (Fig. 23); in others (carnivora and ruminants) it lies throughout its extent above these different turbinals. Schwalbe, Seydel and Killian consider it the first ethmo-turbinal; Peter (1902) separates it from this group. His classification, based upon their origin, separates them from one another, and distinguishes those which arise from the external nasal wall (maxillo-turbinal and naso-turbinal) from those which arise from the internal wall (ethmo-turbinal).

The naso-turbinal, being a turbinal quite distinct in its anatomic relations, is reserved for a special description.

In the guinea-pig (Fig. 23), it is a lamina placed above the inferior turbinal, the superior border of which it covers, ex-

tending from the anterior extremity of this turbinal to the anterior extremity of the ethmoidal turbinals. Its lamina is simple, without rolling.

In the rat it is inserted upon the most elevated portion of the external wall, and is folded inferiorly; it begins a little behind the anterior extremity of the inferior turbinal and terminates at the same level as the latter. Its posterior border is notched by the anterior extremity of the superior ethmoidal turbinal.

In the cat the naso-turbinal presents another appearance; it is inserted along the entire nasal roof; it runs along it, and does not descend towards the inferior turbinal to form a ridge be-

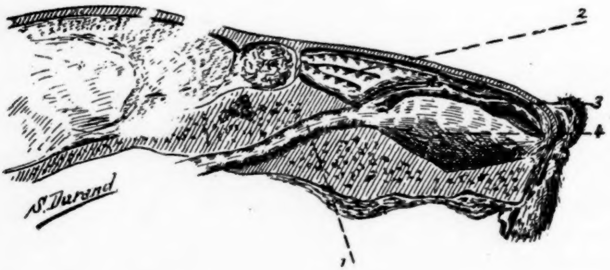


Fig. 23. Twice natural size. Guinea-pig (Sagittal section, passing external to the median line, showing the external nasal wall. 1. Naso-pharyngeal canal; 2. Ethmo-turbinal; 3. Naso-turbinal; 4. Maxillo-turbinal.

tween it and the ethmoidal turbinals. Its anterior extremity is situated between the nasal roof and the inferior turbinal. Schönemann represents it thus in the embryos of the cat, calf and rabbit. In this disposition it is not a middle turbinal, but an anterior, or, better, an antero-superior turbinal. It is the ethmo-turbinal I.

In the sheep and badger, the naso-turbinal is a simple, slightly projecting margin, placed along the nasal roof. It is represented in man, but it does not correspond to the middle turbinal.

Schwalbe (1[illegible]) has shown that the ridge which v. Meyer called th[illegible]ger nasi is a vestige of it; Zuckerkandl describes

the agger nasi as the pars libera, and the uncinate process as the pars tecta of the naso-turbinal of man. The agger nasi is a ridge placed upon the frontal process of the superior maxillary, joined to the middle turbinal (Zuckerkandl, Pl. IX., Fig. 4; Schwalbe, *Anat. der Sinnesorgane,* 1887, Fig. 27). Schwalbe considers it the rudiment of the anterior turbinal.

So the naso-turbinal is, in certain cases, a middle turbinal, intermediate to the maxillo-turbinals and ethmo-turbinals (guinea-pig, rat); in other cases it is an anterior turbinal (cat, rabbit), and in others (monkey, man) it is reduced to a simple ridge.

ETHMO-TURBINAL (olfactory turbinals or projections, baso-turbinal of Schönemann, conchae obtectae, ethmoidal volutes, middle and superior turbinals of man).—The number of olfactory turbinals varies in mammals from three to nine, the number five being most common (carnivora, rodents, insectivora, lower monkeys). Zuckerkandl distinguishes the lateral olfactory projections from those which freely arise from the median wall. Seydel names them principal and accessory turbinals. They all have a simple lamina of origin from the ethmoid (Schwalbe). Karl Peter (1902, 1) distinguishes them from the lateral turbinals (maxillo-turbinal and naso-turbinal) by the generic name of medial turbinals. Schwalbe (1883), Seydel (1891), Killian and Zuckerkandl consider the naso-turbinal as an ethmoidal turbinal, regarding the olfactory projection as more important than Peter does.

The ethmo-turbinals are characterized as ridges inserted upon the anterior surface of the ethmoid, and are free in the nasal cavity. Together, they form a triangular mass with attached base (baso-turbinal). This ridge may be cut by grooves of the external surface into the form of projections, or completely subdivided into distinct lamellae. The different turbinals are generally parallel to one another, their volume is not uniform and their length diminishes from above downwards.

Among the monotremes, Ornithorhyncus, according to Simon Paulli (1900), has a very much reduced ethmoid, while in Echidna it is well developed and very complicated.

In the marsupials, the carnivora are recalled (Chatin). According to Simon Paulli, it is divided into five turbinals, a number typical in mammals (including naso-turbinal). In Cheiropteres vespertilionides, Otto Grosser describes two

series of ethmoidal turbinals. A rudimentary naso-turbinal exists in the median series. The second is the largest, the third and fourth the smallest. They are very simple, being thick lamina in the form of a club on their free border.

The badger has a large middle ethmoidal turbinal with a pointed ending anteriorly. Superiorly and inferiorly it ends in a series of fine lamellae disposed antero-posteriorly.

The sheep is provided with a large turbinal inserted by its base upon the median portion of the ethmoid in the form of a triangular pyramid with apex anterior. Its inferior surface is applied against the posterior border of the maxillo-turbinal, its superior surface answers to the other ethmoidal turbinals. Internally it has a plane surface, externally a round border. It may be described as a middle turbinal on account of its situation.

Above and behind this turbinal, the ethmoid supports four others, which are almost cylindrical projections separated from one another by deep longitudinal grooves; they are free on their anterior extremities. There are four turbinals in the goat. According to Simon Paulli, the fissure formation is at a minimum in the ruminants, but in the other ungulates the number may reach eight (horse). It is the same in the rhinoceros, tapir, pig and the peccary.

Among the rodents the guinea-pig has three ethmoidal turbinals (Fig. 23); they are not completely separated from one another, the superior and middle being united at their anterior extremity; the inferior has a free anterior extremity. They form together a triangular ridge inserted by its base upon the anterior surface of the ethmoid, being free on all other sides.

The rat has four ethmoidal turbinals; the superior is longest and reaches greatly beyond the second, which reaches beyond the third. The first three turbinals are curved and directed downward at the level of their anterior extremity. The fourth or inferior turbinal has a free pointed anterior extremity.

The cat has a well-developed collection of ethmo-turbinals. We may distinguish a superior turbinal, parallel to the roof of the nose; a second turbinal, parallel to the preceding and applied along its inferior surface, united anteriorly to two laminae extending downwards and backwards. Between these laminae and the anterior portion of the ethmoid, a triangular ridge is interposed which is flattened transversely and placed between the ethmoidal lamellae and the septum. In all there

are three turbinals, one of which is divided into two. According to Simon Paulli, bears have seven olfactory projections and the Mustelidae six to seven. In Pinnipedia the number is five to six.

In the prosimians (Lemur cotta) Seydel describes four olfactory projections, besides the naso-turbinal. They arise from three basal lamellae, the first of which has two rolls. There are three principal and two accessory turbinals, of which the superior limits the frontal sinus below, while the other lies between the first and second principal turbinals.

In the lower monkeys the number of ethmoidal turbinals, according to Zuckerkandl, varies from one to three; the mycetes have only a single turbinal.

The anthropoid apes exhibit a striking resemblance to man in respect to the ethmoidal turbinals. These turbinals are no longer inserted by distinct pedicles. The nasal surface of the ethmoid labyrinth presents, as in man, a furrow, which determines the formation of two or three turbinals, ending in a point posteriorly. Zuckerkandl found in Hylobates concolor three turbinals on the left and two on the right side; in the orang one and rarely two; in the chimpanzee three in one instance and four in another; in the gorilla sometimes three and sometimes two.

In man, Zuckerkandl (1895) finds, on the median wall of the ethmoid labyrinth, two or three clefts dividing the osseous lamina into three segments, and exceptionally into four. Three typical ethmoid turbinals are designated under the name of inferior, middle and superior. The inferior ethmoidal turbinal resembles the maxillo-turbinal; the posterior extremity terminates in a point beyond the labyrinth; the anterior extremity, which is truncated vertically, is shorter by one to two centimeters than that of the maxillo-turbinal, and it is continuous with the agger nasi. The anterior extremity of this turbinal may be transformed into a large vesicle (concha bullosa). The middle ethmoidal turbinal is placed above the inferior and is shorter by 7 to 15 mm.; its form and extent are very variable and it is sometimes rudimentary.

The superior ethmoidal turbinal, irregularly quadrangular, is placed between the superior ethmoid cleft, the cribriform plate and the anterior wall of the sphenoid sinus. It may be transformed into a vesicle or in other cases it may have a spherical ridge limited in one place.

The fourth or supreme ethmoidal turbinal is found by Zuckerkandl in 6.7 per cent of the cases. When it is well developed it has the form of the middle ethmoidal turbinal, but it is sometimes reduced to a simple ridge.

Behind the uncinate process, which, with the agger nasi, represents the naso-turbinal, is found constantly, says Zuckerkandl, an osseous, hollow, round projection, which forms part of the ethmoid labyrinth. Its convexity is towards the middle meatus and it is covered by the inferior ethmoidal turbinal. This is the bulla ethmoidalis. This projection corresponds to an atrophied olfactory projection.

Resume.—The maxillo-turbinal, the most inferior and anterior of the turbinals, exhibits only two types in the series of mammals: rolled or branched.

The branched turbinal presents every degree from the simple turbinal crossed by longitudinal grooves, as in the Echidna, to the branched turbinals of the third degree, disposed in every direction, as in the badger. The rolled turbinal may present a single lamellar coil (solipeds, rodents, man) or two laminae, one above and one below the lamina of insertion (pachyderms, ruminants).

The naso-turbinal placed above the maxillo-turbinal may be parallel to it and may insinuate itself between its posterior extremity and the ethmo-turbinals (guinea-pig, rat), or it may be parallel to the roof of the nose and pass backward above the ethmo-turbinals (ruminants, carnivora). It is reduced to a simple ridge (agger nasi), anterior to the middle turbinal, in man.

The ethmo-turbinals, varying in number from three to five, are inserted in the posterior part of the nasal cavity, upon the body of the ethmoid. Their form is that of a triangle with a base posterior. They are sometimes united together (guinea-pig), sometimes completely separated from one another (badger). At other times one of the turbinals may be very voluminous and entirely detached from the others, which are united together (sheep). The typical number is five, as found in the marsupials. In man the ethmoidal turbinals are represented by the middle and superior and accessory turbinals and by vestiges such as the bulla ethmoidalis.

The presence of turbinals greatly augments the surface of the olfactory and respiratory regions. This augmentation is:

In the sheep, 4.9 times for the olfactory and 1.52 times for the respiratory surface;

In the dog, 2.46 times for the olfactory and 1.48 times for the respiratory;

In man, 1.30 times for the olfactory and 1.39 times for the respiratory.

Accessory Cavities or Nasal Sinuses.—These are the hollow cavities of the bones of the face and head in the neighborhood of the nasal fossae, with which they communicate. They are covered by a mucous membrane continuous with that of the nasal apparatus.

We have already stated that, as a general rule, their orifices open into the respiratory region with the exception of the sphenoidal and some ethmoid cells which open into the olfactory region.

The older writers who make mention of the sinuses appeared to be greatly interested in the nature of their contents. A large number insisted on the presence of a green membrane, membrana viridis; e. g., Laurentius (1628), Spigel (1645), Bauhinus, Olhafius, De Marchettis (1654).

Schneider claimed that this was a cadaveric phenomenon. Others held that these spaces had medullary contents. The following may be cited as holding this opinion: Albertus Salomon (1583), Bartholinus (1658), Jessen (1601), Kyper (1660), Veslingius (1637), (Palfyn (1712), Vesalius (1725) Fallopius (1562) and Diemerbroeck (1685) held that the frontal sinus and the other accessory cavities were alternately filled and empty.

Fallopius claimed that only air and mucus were present.

According to Valverda, Columbus, Riolan (1618), Vereheyn and Schneider, the sinuses contained air.

Highmore (1681) advanced the idea of the pneumatisation of the sinuses. Riolan (1649) was the first to make a study of the cavities together.

Vieussens and Haller thought that the sinuses had the function of secreting mucus.

After the latter, anatomists were divided into two camps: Those holding his view, Arnold, Bidder, Haarwood, Huschke, Hyrtl, Magendie, Rudolphi and Walter; others holding that the sinuses and cavities were pneumatic, Braune, Clasen, Langer, Meyer and Weber.

Zuckerkandl remarks that we have not gone beyond the accurate observations of Columbus, Fallopius, Riolan and Schneider.

The volume of the sinuses varies greatly in the different species of mammals. While Richerand states that the sinuses are tremendously developed in all animals which excel in the acuity of olfaction, Müller claims, on the contrary, that the principle which presides over the formation and modification of the organ of olfaction is the multiplication of the olfactory surfaces in a small space.

Braune and Clasen (1877) have measured the volume of the nasal cavities and the various sinuses in man. The average figures corresponding to them are as follows:

Right frontal cavity......	3.1 cc.	left, 3.4 cc.
Right sphenoidal	4.0 cc.	left, 1.8 cc.
Right ethmoidal	3.1 cc.	left, 4.5 cc.
Right maxillary	12.5 cc.	left, 11.6 cc.

The total volume of the two sides was 44 cc., of the two nasal cavities 30.5 cc. The ratio was 144 to 100.

Zuckerkandl and Seydel, without according to the sinuses a role in the phenomenon of olfaction, claim, especially as to the frontal and sphenoidal, that these cavities include portions of the powerful ethmoid labyrinth in animals with great olfactory power.

In microsmatic animals and in man, the nasal cavity is sufficient to contain the reduced ethmoid, and the sinuses, thenceforth free, disappear or remain as empty cavities.

Simon Paulli does not accept this view, which is erroneous, for Zuckerkandl has confounded portions of the nasal cavity with the pneumatic spaces.

According to Simon Paulli, pneumatisation of the cranium is missing in monotremes and marsupials.

The kangaroos, however, according to Cuvier, have a frontal sinus.

Sinus Maxillaris.—The maxillary sinuses, according to Cuvier, are smaller in the Quadrumana than in man. They are reduced almost to nothing in the carnivora, the rodents and the edentates. In most of the other unguiculates they exist, but are a part of the nasal cavity, from which they are not separated by a narrow opening. The pachyderms have no sinus maxillaris, but they have a malar sinus.

In the insectivora the maxillary sinuses are the only pneumatic cavities. They are very large in the ruminants, and open into the nose by an oblique and narrow cleft situated behind the inferior turbinals. Those of the sheep are long antero-posteriorly; upon transverse section they have an elliptical form, but their inferior wall makes a large ridge in the cavity because of the dental alveoli. They are relatively very large.

The maxillary sinus of the horse is divided into two compartments by the supermaxillo-dental canal which traverses it. The internal compartment communicates with the sphenoidal and ethmoidal sinuses, its wall making a ridge in the interior of the nose.

In the elephant the sinus maxillaris is immense, separated from the nasal cavity by a very thin, bony wall. It is partitioned into a multitude of very large cells.

In the carnivora the ethmoid labyrinth, according to Zuckerkandl, forms a projection into the sinus and narrows it. We have not seen a sinus maxillaris in the cat.

In the monkeys the sinus maxillaris is very spacious. In the orang it forms, with the hollow space which replaces the ethmoid cells, a large single cavity, which leads into the sphenoidal sinus.

In man this is the largest of the accessory cavities. It is external to the lateral walls of the nasal cavity and below the floor of the orbit. Its form is that of a triangular pyramid with a base superior, or to the orbital side. It opens into the nasal cavity by two orifices, a principal (ostium maxillare) joining with the frontal opening in the region of the infundibulum, in the middle meatus, lying behind the bulla ethmoidalis. This will be discussed in connection with the frontal sinus. The other accessory orifice (ostium maxillare accessorium) is inconstant, occurring once in ten times. It was discovered by Giraldés; it is situated in the posterior part of the middle meatus (Zuckerkandl, 1895).

Frontal Sinus.—The frontal sinuses are lacking in a large number of animals. Among the ruminants, the deer is unprovided with them. In cattle, sheep and the goat they are very extensive. The sheep's frontal sinuses are very large cavities, occupying almost the whole extent of the frontal bone, provided at their antero-internal angle with an orifice which is directed towards the nasal cavity and prolonged upward into the bony

processes which support the horns. The mucosa which covers them forms, in the vicinity of the median line, one or two folds which isolate some small spaces.

The rodents generally are not provided with frontal sinuses, but we have seen a small one in the Indian hog. Cuvier reports very large ones in the porcupine, in which they penetrated into the depths of the nasal bones.

The horse's frontal sinuses extend into the frontal bone and open into the posterior or internal compartment of the sinus maxillaris.

Baum (1894) has examined sections from the heads of 80 horses, and considers the communication established by the large opening between the frontal sinus and the maxillary to be physiologic.

They are very large in the elephant, and extend not only into the frontal, but also into all of the bones of the cranial vault. Anteriorly, the nasal and the intermaxillary bones are hollowed out by air spaces.

All of these bony cavities, partitioned and subdivided into cells, communicate with one another. A horizontal section across the head of an Asiatic elephant, to be seen in the new galleries of the Museum of Paris, shows beautifully the extent of all of these spaces.

Among the Carnivora, dogs, wolves and hyenas have very extensive frontal sinuses, which descend to the posterior wall of the orbit. They are less developed in the cat, being limited to the median part of the frontals.

They are less extensive in the cercopithecus, and are wanting in many monkeys.

Zuckerkandl (1887), after a comparative study of the frontal sinuses, established a distinction between the macrosmatic mammals and the microsmatic primates. The former have at least one excavation in the nasal portion of the frontal bone. The irregular distribution of the frontal sinus in the series of mammals does not appear to justify this classification.

In man the frontal sinus has the form of a triangular pyramid, its base being formed by the passageway between the squama and the roof of the orbit, and by the excavation of the nasal portion of the bone. A median sagittal partition separates the sinuses from one another. The volume varies considerably, even constituting a racial characteristic. In southern negroes it is greatly reduced. According to Steiner (1874)

the frontal sinuses may have ethmoid cells included within them.

Boege (1902) considers the frontal sinuses as extensions of the ethmoid mucosa. They communicate rarely through the partition, 1 per cent of the cases. Two frontal cavities are rarely found on a single side, 1.5 per cent. They are absent in 4.9 per cent of the cases, an opinion which Poirier (1892) accepts.

Mouret (1902) has found several double frontal sinuses independent of one another; each of these opens singly into the corresponding nasal fossa; the more anterior one is considered as the principal sinus, the other, the nasal orifice of which is posterior to that of the former, is the supplementary sinus. The supplementary sinus, according to this author, is formed by a dilatation of the anterior ethmoidal cell, which he calls the posterior frontal bulla.

The frontal sinus opens, in common with the maxillary sinus, in an excavation of the middle meatus, situated upon the ethmoid and bounded by the bulla ethmoidalis and the uncinate process. Boyer has given to this depression the name of infundibulum. Zuckerkandl calls it the hiatus semilunaris. This space is accessible on account of the disposition of the inferior turbinal, which, at the level of its anterior extremity, is not adherent to the external wall, but hangs in the form of a triangular strip. (Raugé, 1894.)

Ethmoid Cells.—The ethmoid cells, which occupy the thick portion of the ethmoid bone, are spaces of small dimensions, communicating with one another; their number is very variable.

Simon Paulli remarks that the number of pneumatic cavities in the ethmoid has no relation with the total volume of pneumaticity nor with the size of the animals. In several carnivora, in the prosimians and platyrrhinans, the number of the cavities is restricted; it is important in many of the ruminants, and may be much reduced in many of the large animals (horse and hippopotamus).

Zuckerkandl found shallow ethmoidal cells when the ethmoidal turbinals were slightly developed (lower monkeys). In the orang a large hollow space is found, instead of cells, between the lamina papyracea and the wall of the ethmoid turbinals, communicating with the maxillary sinus.

Zuckerkandl has described these cavities in man; they are spaces situated between the ethmoidal turbinals, being of the

nature of interturbinal meatuses. They are hollow cavities in the thick portion of the turbinals and the bulla ethmoidalis.

Sphenoidal Sinus.—The sphenoidal sinus is absent in a large number of animals, otter, seal, pole-cat, ruminants and cetaceans; it is very small in the pig and hippopotamus; in the horse it is the smallest of the sinuses and is partitioned; it is very small in the carnivora and in the monkeys. The rudimentary development in mammals, as remarked by Zuckerkandl, depends generally upon the fact that the sinus usually has no anterior wall and does not exist as a true sinus, but simply as a form of excavation or anfractuosity of the olfactory region of the nasal cavity. It is thus in the echidna, the marsupials, the edentates, the artiodactyles, with the exception of the pig, the rodents and the insectivora, which have a sphenoidal sinus in the form of a niche.

It often has for its function the lodgement of the olfactory projection. In microsmatic animals the sinus, which is empty, has an anterior wall with an ostium sphenoidale (Zuckerkandl).

In man it is a hollow cubical cavity in the body of the sphenoid, divided into two parts by a median partition, each cavity having an anterior orifice which opens into the corresponding nasal cavity.

The sphenoidal sinus is often limited anteriorly by lamellae called sphenoidal turbinals, which are portions of the ethmoid.

Resume.—Most of the accessory cavities open into the nasal cavity at the level of the respiratory region (frontal, maxillary sinuses and anterior ethmoidal cells).

The maxillary sinus is very much reduced in the carnivora, the rodents and the edentates. It is replaced by a malar sinus in the pachyderms. It is very large in the ruminants, the solipeds, proboscidians, primates and man.

The frontal sinuses are absent in certain groups or in certain species (absent in the deer, well developed in cattle, sheep and the goat). They are absent or very small in the rodents. They open into the maxillary sinus in the horse, and they are very large in the elephant. They are absent in many of the monkeys. In man their volume is variable (absent in negroes of the south). They are formed by ethmoidal cells enclosed in the frontal (Steiner). The ethmoid cells are spaces of small dimensions communicating with one another. They are numerous in the ruminants, being much reduced in the horse and hippopotamus. They form a single cavity in the orang.

The sphenoidal sinuses are often lacking (otter, seal, ruminants and cetaceans) or much reduced (pachyderms, proboscidians, carnivora and monkeys). They often have for their function the lodgement of the olfactory projections.

The total volume of the accessory cavities in man is greater than that of the two nasal cavities, the relation being 144 to 100 (Braune and Clasen).

Organ of Jacobson.—Ruysch (1703), Sömmering (1809) described in man a canal corresponding to the organ of Jacobson, but without giving to it its significance. Jacobson gave a description of it in 1811 and it was studied by Cuvier and Gratiolet (1845).

Huschke noticed the paranasal cartilage or the cartilage of Jacobson. Dursy described this organ in 1869 and Kölliker (1877) noted the presence of the organ of Jacobson in the human adult. Remy (1878) made some observations in different mammals and confirmed the description of Cuvier. The orifice of the receptacle of Jacobson in the canal of Stenson has the form of a linear furrow, which recalls the orifice of the nasal canal in the middle meatus. Its mucosa is analogous to that which covers the nasal fossae.

Klein (1881) studied this organ in the India pig. It is a tube opening frontally into the canal of Stenson; behind it terminates in a cul-de-sac. It is enveloped by a hyaline cartilage which forms an incomplete capsule. The wall consists of epithelium, a fibrous subepithelial coat, a layer of cavernous tissue and a glandular layer. The epithelium, like that of the nasal cavity, is composed of a superficial layer of cylindrical or conical cells, between the extremities of which are placed fusiform or inverted conical cells. The superficial surface of the cells is provided with fine cilia.

Balogh has found the same epithelium in the sheep. The alveolar glands are more developed in the region where the capsule is deficient.

In the rabbit Klein (1881) found an organ of Jacobson longer than that of the India pig. In the latter the organ is distinguished, moreover, by direct communication with the nasal cavities.

Harvey (1882) describes an analogous orifice in the mouse. The organ has no relation with the canal of Stenson. In the cat and hedgehog, on the contrary, there is a direct communi-

cation between the anterior extremity of the organ of Jacobson and the canal of Stenson.

Klein (1882) described the organ of Jacobson of the dog, which is placed in the inferior part of the septum, corresponding to a small prominence above which a larger one lies; it is the special ridge of the cartilage of Jacobson which causes the superior prominence. In a dog of average size the length of the organ is 3 cm. It does not open directly into the nasal cavity, but into the canal of Stenson by its anterior extremity. The latter is covered by stratified pavement epithelium; in the upper, large region, the most superficial cells are cubical. The intermaxillary bone has an important role in supporting the organ of Jacobson.

The cartilage which surrounds this organ is curved crescentically on transverse sections. The structure of the organ, studied in extensive detail by Klein, does not differ from that of the India pig or the rabbit, except that the cavernous tissue, so well developed in the latter animals, is absent in the dog.

Gegenbaur (1886) advances the opinion that the obliterated tube, which is considered in the adult man as a rudimentary organ of Jacobson, is an excretory canal of a nasal gland situated in the septum. It is removed from the cartilage of Jacobson, with which it should be in relation, and its situation corresponds to that of the septal gland of acinous structure, which is well developed in the prosimians.

Herzfeld (1888) published a very important work in which he discusses the presence or absence of the canal of Jacobson and of the naso-palatal canal, and the structure of the different parts of this organ. The following are his conclusions:

1st. The canal of Jacobson opens into a distinct naso-palatine canal in the ruminants (sheep, goat, ox), pig, dog, cat, mole, lemur, macaco and Hapale penicillata;

2d. No naso-palatine canal exists, but a diverticulum is found into which the canal of Jacobson opens (horse, ass);

3d. The naso-palatine canal exists, but the canal of Jacobson opens into the nasal cavity (rabbit, hare and rat);

4th. The nasal cavity is united to the buccal cavity by an open naso-palatine canal, the organ of Jacobson being wanting (bat, Pteropus edwarsi, Cercopithecus fuliginosus);

5th. Canal of Jacobson and naso-palatine canal both absent (seal). Man forms a group apart, for he possesses, at the level of the septal wall, the canal of Ruysch, which in other mammals is replaced by glands.

Herzfeld, in reference to the structure of the organ, notes the presence of a venous sinus situated laterally between the mucosa and the cartilage.

Symington (1891) describes the organ of Jacobson in marsupials; it is very well developed and resembles that found by Parker in the monotremes. It is a simple epithelial tube, communicating anteriorly with the naso-palatine canal, and surrounded by a cartilage in the shape of a "U." In the Ornithorhynchus, also studied by this author, the cartilage forms a complete tube in a large part of its extent. The organ extends anterior to its opening into the naso-palatine canal.

Potiquet (1891) studied, in the human adult, the canal of Jacobson, a vestige of the organ of the same name. It is found easily enough in the cadaver, at least when lesions of the mucosa do not cause its obliteration. He examined for it in the living. Although it is not as easy to discover it as in the cadaver, it was found quite often.

It is situated above a projection, elongated from before backwards, and constituted in part by the cartilages of Jacobson; it occupies the antero-inferior portion of the septum. A large number of affections of the septum (syphilides, ulcerations, perforations, repeated epistaxis) attack the region of the canal of Jacobson, perhaps indicating the localization of the pathologic process at this place.

Mathias Duval and Gernault (1895) made observations on the organ of Jacobson in the Cheiroptera; they noted its absence in the murin and in the horseshoe bat and they found traces of it in the embryos of the pipistrel. The canal of Stenson is closed early in the murin and horseshoe bat, but persists in the pipistrel.

Broom (1896) studied the organ of Jacobson in Echidna; the palatal cartilage contributes to form the cartilaginous framework. The cartilage has the shape of the letter "C" in its anterior part, and then takes the form of a complete ring.

A band of cartilage, the turbinal cartilage, in relation with the external wall of this cartilaginous tube, supports the glandular tissue.

The epithelium described by Broom is sensory in character. This author also examined the organ in the Ornithorynchus, finding differences in the disposition and extent of the cartilages.

Mikalhovics (1889) studied the organ of Jacobson, or

vomero-nasal organ, in a certain number of mammals. In the mole the organ is located in a fossa of the vomer; the cartilage of Jacobson or paranasal cartilage is situated above the canal, and is not in relation with it. Some serous glands lie on the lateral side of the organ. On the caudal part, the glands are more numerous and the tube more narrow. Anteriorly it opens into the canal of Stenson and has a common cylindrical epithelium.

In the mouse it is independent of the paraseptal cartilage; anteriorly it opens into a groove placed above the canal of Stenson; it lies partially in the intermaxillary and partially in the vomer.

In Ungulata and Carnivora the organ of Jacobson is analogous to that of the rodents; it lies in the "C" shaped cavity formed by the paraseptal cartilage. In man the canal of Jacobson is present during embryonic life. Later it is represented only by the paraseptal cartilages.

Mangakis (1902) has observed in the human adult the organ of Jacobson, first described by Kölliker, then by Merkel and Anton. It was in a young soldier that Mangakis found this organ, which had the form of a canal and was 6.2 cm. long. The anterior orifice was visible without rhinoscopy. It communicated with that of the opposite side through the septum, the posterior opening, narrower than the anterior, lying free in the pharynx. Histologic examination of three fragments showed the presence of olfactory cells like those described by Merkel.

We made a microscopic study of the organ of Jacobson in the sheep. It is located in a longitudinal fossa of the vomer, opened considerably externally and superiorly. It is surrounded by a complete cartilaginous tube, which comes in contact with the nasal cartilage on its superior border. This cartilaginous canal is 3 mm. wide transversely, and 5 mm. vertically; its circular cavity has a diameter of 2 mm.

The organ of Jacobson, which fills it completely, is a cylindrical tube, the walls of which are 0.5 mm. thick and the lumen 1 mm. in diameter. The total length is 7.6 cm. The head of a sheep is 23.5 cm. long, and the nasal fossa 11 cm.

Anteriorly, the tube of Jacobson opens into the naso-palatine canal. It is widely opened, and at the level of the roof of the mouth it is widened into a fossa, and is directed towards the nasal cavity, obliquely across its floor. The opening of the

organ of Jacobson lies concealed behind a mucous fold of the internal border, at the anterior extremity of the buccal opening of the naso-palatine canal.

We have studied the organ in the mouse, by histologic sections (Fig. 20). Its situation is, as in the sheep, in a fossa of the vomer. We found no cartilaginous envelope, but a thick fibrous wall. The organ presents walls of great thickness on transverse section, 128 mikra at the level of the internal wall, and 185 at the level of the external. In toto, it forms an elliptical mass, the diameters of which measure 400 mikra vertically and 357 transversely.

The lumen, elongated vertically and narrowed transversely, has the form of a crescent with concavity external, with a height of 178 mikra and a width of 28. The external wall forms, in the cavity, a convex ridge analogous to the ventral ridge of the organ in reptiles.

The walls are uniform throughout, and are formed by a thick cellular mass of closely applied polyhedral or round cells provided with a large nucleus.

The cells which border the lumen of the organ are much elongated and present two very distinct portions, one deep and dark, containing the nucleus, and an internal, very clear and homogeneous. The cells are not so high on the external wall as on the internal.

The organ of Jacobson in the cat lies below a large ridge of the septum. Its anterior opening does not enter a permeable naso-palatine canal, as this is closed by the buccal roof.

Nasal Mucosa.—(*a*) *Macroscopic Aspect.*—Schneider (1645) gave the first exact description of the pituitary membrane. He refuted the ancient view which ascribed the flow to the discharge of liquid humors of the brain through the cribriform plate.

This mucosa covers the entire extent of the nasal fossae and sinuses; behind it is continuous with the pharyngeal mucosa, anteriorly with the skin. It is very adherent to the subjacent periosteum. Nevertheless it can be separated from it, and Remy rejects the expression "fibro-mucosa."

Its thickness varies according to the region; it is thinner in the olfactory fossa than in the respiratory portion, thicker over the inferior turbinals than over the other turbinals, with the exception of the inferior border of the middle turbinal in man.

Its internal surface is covered with mucus; it is smooth,

but in the posterior portion Kölliker observed folds and ridges, directed from above downward and from behind forward. These folds are found only in the infant and disappear later. Its color is an intense red in the living, but it is not uniform. In the superior part it shows a yellowish color, noticed for the first time by Todd and Bowmann. The yellow color marks a region which the writers name regio olfactoria, and which Ecker has called locus luteus. It is in this region that the branches of the olfactory nerve end (M. Schultze, Ecker, Eckardt and Rémy). The color may be brown or yellow, depending on the animal.

The topographic situation of the olfactory region is easy to determine on account of this coloration, and besides, the histologic examination fixes it at about the same limits. We may say in general, that the olfactory mucosa covers the entire extent of the ethmo-turbinals and of the grooves which separate them, the nasal roof and the septum in the corresponding region. It extends only to the level of the naso-turbinal upon its posterior extremity; upon the external wall it never reaches the meatus subjacent to the inferior ethmo-turbinal.

In man this rule is verified, since the sensory mucosa comes to the inferior border of the middle turbinal (inferior ethmoidal turbinal). However, according to the researches of Max Schultze and Hermann Suchanneck, it is less extensive upon the middle turbinal and covers only the superior half, while Battista, Grassi and Castronovo (1889) found upon this turbinal a transitory investment between the olfactory mucosa and the respiratory mucosa.

The extent of the olfactory mucosa, expressed in absolute figures, whether dependent upon the number or dimensions of the ethmo-turbinals, is too much connected with the total volume of the head to give any exact notion. It is more interesting to compare it with that of the respiratory mucosa.

This relation will give a better idea of the peripheral extent of the olfactory organ. We have measured the extent of the two regions, olfactory and respiratory, in different animals. For this purpose we have cut paper squares of 4 mm. on each side, and, fragment by fragment, we have covered the entire surface to be measured, taking account of the hollows and ridges. If we do not arrive at absolute exactness, at least we have a sufficient approximation, for the points of error remain the same for both regions. The following are the figures which we have found in certain animals:

	Respiratory Surface.	Olfactory Surface.	Ratio.
Sheep	33.00 cc.	8.84 cc.	3.73
Guinea-pig	2.08 cc.	1.12 cc.	1.85
Rat	1.60 cc.	1.12 cc.	1.33
Cat	6.08 cc.	5.76 cc.	1.055
Dog	12.08 cc.	9.76 cc.	1.23
Monkey	9.76 cc.	4.16 cc.	2.34
Man	10.40 cc.	3.08 cc.	3.37

According to these figures, the dog, cat, rat and guinea-pig are macrosmatic; the sheep, monkey and man are microsmatic.

This classification agrees with those of Broca and Turner, which are based upon other anatomic conditions, such as the extent of the olfactory region of the brain.

Braune and Clasen, who measured the volume of the nasal cavities, found that the amount of air entering the olfactory region during sniffing was one-tenth of that passing through the respiratory region.

(*b*) *Structure.*—We can distinguish an epithelium and a corium containing glands, vessels and nerves.

Epithelium.—The epithelium is the place in which the differences between olfactory and respiratory regions reside.

The epithelium of the respiratory region is composed of long, cylindrical cells, enlarged at one extremity and attenuated at the other, with a nucleus in the middle of the cells. The enlarged extremity of the cell has vibratile cilia, generally curved outwards. Below and between the deep prolongations are round cells. At the level of the nares, this mucosa is united to a covering which has all the characteristics of the skin. The transition is abrupt, according to Rémy.

According to Eckhardt, Ecker and Max Schultze, the epithelium of the olfactory region possesses two kinds of cells, viz., cylindrical and fusiform cells. Max Schultze described the fusiform cells as characteristic of olfactory epithelium. They are in intimate relation with the fibres of the olfactory nerve and are the peripheral ends of this nerve.

Cisoff (1874) saw the prolongations of the olfactory cells penetrate into the subepithelial layer, into which the fibres of the olfactory nerve also enter. It is rarely possible to demonstrate the fine nervous fibrils in communication with the olfactory cells, but Sidky (1877) admits this communication.

Von Brunn (1880) describes the fusiform cells as sensory cells in direct union with the branches of the olfactory nerve; he describes, on the surface of the epithelium, a homogeneous membrane (membrana limitans) which permits the peripheral prolongations of the sensory cells to pass through the pores.

Delavan (1880) and Tourneux (1883) found the same elements as Von Brunn.

Grassi and Costranovo (1889) studied the distribution of the varicose fibrils of the olfactory nerve of the dog; upon their entrance into the connective tissue of the mucosa, they divide into horizontal branches parallel to the epithelial layer; of these branches, there are divisions which enter into the olfactory cells, but some fibrils end directly in the cells without following a horizontal course.

Hermann Suchanneck (1890) gives an entire series of distinctive characteristics between the two epithelia, olfactory and respiratory, but he does not find the membrana limitans of Von Brunn. Ramon y Cajal finds that each olfactory fibril preserves its absolute independence from the olfactory bulb to the cell in which it terminates. It never anastamoses with the neighboring fibrils, and does not divide at any point in its passageway. The olfactory cell is a bipolar nerve cell, and its internal prolongation is a fibre of the olfactory nerve.

Fusari (1894), like Grassi and Costranovo, finds the same nerve fibrils passing into the basal prolongation of several olfactory cells. In the epithelium of the organ of Jacobson he observed that one portion of the fibres of the olfactory nerve entered directly into relation with the basal process of the epithelial cells. The others, at the base of the epithelium, were in relation with a globular nerve cell, which sent towards the periphery slender prolongations scattered between the epithelial cells.

Van Gehuchten (1890) agrees with Ramon y Cajal, that the fibrils pass directly into the olfactory cells without ramification, and after a slightly waving course. The nerve prolongation is continuous insensibly with the cellular mass, and at the other pole the protoplasmic substance forms a thick peripheral prolongation, which extends to the free surface of the epithelium.

The ordinary epithelial cells present a cylindrical peripheral portion and an irregular central portion, often terminating by bifurcation at the internal limits of the epithelium.

Disse (1900) has found, in the calf, olfactory buds lying upon the internal wall of the ethmoidal labyrinth, and upon a field corresponding to the septal wall. They are spherical in form and present a pore, open upon the surface of the mucosa, and enclose replacing and sensory cells.

The olfactory epithelium is thicker than the respiratory epithelium; in the mouse it attains a thickness of 128 mikra at the level of the olfactory fossa, and 21 mikra at the level of the external wall, below the naso-turbinal. The cells are of two kinds: fusiform, sensory united by varicose prolongations with the fibres of the olfactory nerve, and epithelial, supporting cells of cylindrical form.

The deeper shade of the olfactory region results, according to Tourneux, Hermann Suchanneck, etc., from the presence of colored granules in the epithelial cells, and according to Rémy, from infiltration of the corium by the fusiform bodies filled with yellow matter.

Corium.—*Glands.*—The connective tissue corium contains glands and vessels, distributed in an irregular manner.

The glands are particularly compact at the level of the lateral and inferior wall, where they attain a large size.

In the respiratory mucosa, according to Max Goerke (1897), there are numerous mucous as well as serous glands. The mucous secretion, by becoming dry, checks the movement of the vibratile cilia, so the very fluid serous secretion is of great utility in holding the humidity of the mucus. Schmincke (1902) has studied minutely the glands of the respiratory region in man, which are of a mixed type. He has followed the process of secretion in two kinds of cells; during the period of repose the albuminous and mucous cells are similar.

The lachrymal canal pours out the aqueous secretion of the lachrymal glands at the level of the inferior meatus; the humidity is still further increased in this region if exposed to the passage of a current of air.

In the olfactory region numerous glands are found (Bowmann's glands). In the mouse they form an important supero-internal group. According to Max Goerke, these glands never secrete mucus, an opinion concurred in by Heidenhein, who considers them as serous.

Von Brunn considers all of them as albuminous glands. Their excretory ducts open upon the superior nasal wall, and

upon the portions in the vicinity of the lateral wall and the septum, in the recesses covered by ciliated epithelium.

The adenoid tissue, under the form of small follicles, is quite abundant in the respiratory mucosa; the migratory cells belonging to it are very much diffused (Stöhr), as are those in the olfactory region (Von Brunn). In the dog, cat, sheep, deer, pig, hare, horse and calf the diffused adenoid tissue is very abundant. The follicles attain a large size in the dog (Zuckerkandl).

VESSELS.—*Erectile Tissue.*—The arteries of the nasal mucosa have several trunks; the anterior nasal comes from the facial, the spheno-palatine from the internal maxillary, and the ethmoidal arteries from the internal carotid. Their ramifications have the type of spiral arteries. We have not undertaken their study in mammals. For the description of arteries in man see Zuckerkandl and works on anatomy.

The veins form efferent plexuses accompanying each of the arterial branches. Interest in the vascular system of the nasal fossae lies in the formation of venous networks, situated between the corium and the periosteum, and having the character of cavernous tissue.

Kohlrausch has described a venous network, rich in anastomoses, situated between the periosteum and the mucosa; Voltolini considers these networks as composed exclusively of veins and announced a theory of erection. Zuckerkandl's study (1895) in man is very complete. He observes that the nasal mucosa is thicker in such places as it comes in contact with a large quantity of air. For this reason, a true cavernous body is developed only on the inferior turbinal, on the border of the middle turbinal, and at the posterior extremities of the middle and superior turbinals. In the places where the mucosa is thin there is only a dense venous network, but no cavernous tissue. These cavernous bodies in the nose are formed of two networks; an external, composed of large venous vessels in communication with efferent veins, and a more delicate internal, in relation with the capillaries, which are placed in the system of laminous trabeculae, containing also some muscular fibres. The glandular culs-de-sac penetrate into the vascular layer, so that, while Langer compares the erectile tissue of the nose to the corpus cavernosum, Zuckerkandl compares it to the cavernous tissues of the urethra.

In the cavernous bodies of the penis, the trabeculae repre-

sents disassociated vascular walls and the muscles are irregularly scattered and have more the disposition found around veins. In the nasal mucosa the expansion of the veins into a vascular system is not so marked, and the muscular layer appears more regular.

Kiesselbach reports cavernous tissue on the nasal septum in man, in the region where the organ of Jacobson should lie. This is the locus kiesselbachi, which is very frequently attacked by hemorrhages.

Arviset (1887) and Isch Wall (1887) consider the erectile tissue of the nasal fossae as constituted primitively of capillaries, which later take on considerable development and undergo important modifications.

Isch Wall also found these capillary dilatations in the embryo of the pig, cat and mole.

In the human adult, he studied the cavernous tissue in an executed criminal. The middle turbinal was entirely occupied by lacunae which were very numerous in the corium, and which were distinguished from those of the penis by lessened thickness of the layer of smooth fibres. Towards the surface the tissue is formed by fine vascular meshwork; towards the depths by very large lacunae.

Herzfeld (1889) found that the cavernous body of the nasal mucosa is rich in smooth muscles and elastic fibres. The cartilages of the turbinals are spongy, and their lacunae communicate with the efferent veins of the cavernous tissue.

Pilliet (1891) found the erectile tissue composed of large, irregular cavities, the larger ones situated against the bones, the smaller in the corium. These are neither arteries, veins nor dilated capillaries, such as C. Robin describes.

The muscular elements are disposed in two different planes around the connective tissue walls, the more internal being longitudinal; but it is difficult to establish their direction, by reasön of the bendings of the cavernous sinuses.

In the human fetuses examined from the fifth month to birth, no trace of erectile tissue is found. In the younger embryos of the sheep, horse, pig and rat there is found, between the cartilage and epithelium, only a thick layer of connective tissue with stellate or elongated cells, studded with capillaries; the true erectile organs are developed in this manner (Nicholas). The observations of Retterer (1887) and those of Tourneux (1887) demonstrate that the region which is to be the

seat of the erectile organ is for a long time characterized by the complete absence of blood vessels.

According to Boulai (1896) the vessels which groove the nasal mucosa are very muscular veins, but not erectile tissue; the development of these networks does not in any way resemble erectile tissue, the period of appearance being too early.

In the newly born dog and in the mouse, we have found, beneath the mucosa, a layer of connective tissue containing round and fusiform cells pressed together, between which are placed very large vessels with thin walls, running in various directions. On transverse section, some are found running transversely and others longitudinally or obliquely. These lacunae lie particularly at the level of the external surface, and especially along the free border of the inferior turbinal. At this point there are only venous dilatations.

Aviset found large vascular dilatations in the armadillo. In the buck, the corium of the mucosa contains arteries surrounded by a large number of capillary dilatations, which have neither muscular nor elastic coat. The glands of the mucosa are very rare in the region of the vascular dilatations; elsewhere they are abundant.

The camel, at the level of the septum, presents numerous glands, between which the vascular dilatations are distributed. The rabbit has only a train of dilated capillaries at the level of the septum; likewise the rat.

Pilliet found erectile tissue in the rodents and endentates. In the dolphin and cachelot, the corium, on the contrary, is thick, white, fibroid and very dense.

Arviset has observed that animals living in a wild state have a more abundant cavernous tissue than the domestic animals. This fact is in accord with the general development of the olfactory faculty.

The turgescence of the cavernous bodies of the nose is dependent upon the nervous system: the sphenopalatine ganglion, according to Zuckerkandl, is the vasodilator center for the nasal mucosa.

Hack has well shown the role of the nervous influence. Before Hack, Voltilini explained the erection without nervous intervention. According to his view, the vessels which constitute the cavernous tissue pass from the bony canaliculi, at the level of which the venous walls are wide open, and the blood

enters the cavernous tissue constantly, through the vessels, which are always open.

But if the blood enter easily, it could leave easily, and erection is impossible, so Zuckerkandl judges this theory untenable.

En résumé, Are we dealing with erectile tissue in the nose or not? The true erectile tissue is composed of lacunae, interposed between arteries and veins, whose walls contain smooth muscle fibres (Robin, Tourneux). According to Retterer (1902) the adherence of the capillaries to a dense fibrous tissue especially characterizes the erectile tissue.

Arviset, Isch Wall and Herzfeld consider the vascular network of the nose as capillary dilatations. According to the observations of Kohlrausch, Zuckerkandl, Pilliet and Boulai, who corroborate our observations on the dog and mouse, the dilated veins and lacunae are not identical with those of the corpus cavernosum of the penis; Zuckerkandl compares them to the spongy tissue of the urethra. From a histologic standpoint, the vascular tissue is not true erectile tissue, but it may be said that it is a lacunar tissue, capable of increasing its volume.

By virtue of the presence of the spiral arteries and of a special vaso-dilator system, the afflux of blood into the lacunar tissue may be suddenly increased and the turgescence which results is sometimes considerable. Certain reflexes may provoke it.

The most interesting observations are those which connect the olfactory with the genital apparatus. In animals, olfactory excitations precede genital excitations, so erectile tissue is more developed in wild animals in which the sexual phenomenon is most intensely manifested.

Mackenzie has studied the relation between the nasal and genital organs in man and woman, which, according to him, will depend on the analogy of structure. The turgescence of the nasal mucosa, by a hyperesthetic effect on the nerve terminations, makes the most delicate impressions perceptible, on account of which the cavernous tissue is more developed in wild animals which have the need of great sensibility in order to smell their prey or to scent the female at great distances.

The influence of odors on the generative apparatus is very marked in the human species, according to Cloquet. "The care, which many women take in using perfume, seems to be a proof; she is wise in the art of pleasing, who does not allow anyone to see her until after she has aided her charms by the use of odors."

Fliess, and after him Schiff, Malherbe and other clinicians, have treated the painful attacks of dysmenorrhea by application of cocain tampons to the nasal fossae; they also destroyed, by cauterization, certain zones in the nasal cavity (genital points), and obtained satisfactory results. This is particularly effective in nervous dysmenorrhea. Malherbe, in cases of genital asthenia, excites the genital points in the nose by electric stimulation.

The inverse influence seems better demonstrated. Mackenzie has shown that excessive venery in man causes coryza, due to obstruction of the nares by the dilated cavernous bodies. According to this writer, repeated sensual excitations may cause inflammations of the nose. Isch Wall reports the case of two young people who were affected with epistaxis at each coitus, at the beginning of their genital life.

The accelerated, noisy respiration in the course of the venereal orgasm seems to indicate that there is a partial obstruction of the nasal fossae by the turgescent mucosa.

We have seen chronic coryza in several women affected with retroversion of the uterus, which is always accompanied by utero-ovarian congestion.

It is only rarely that women breathe normally through the nose, but sleep with their mouth open, during their menstrual periods.

LYMPHATICS.—Well studied in man by Sappey and then by Simon (1859). The latter found in the nasal fossa the justification of a law proposed by Sappey, that the lymphatics of a region are more abundant as its sensibility is more developed.

The lymphatic network of the septum ends by six to eight trunks in the lymphatics of the lateral walls. There it exists as a superficial network at the level of the superior turbinal, of the anterior half of the middle turbinal and of the space in front of the turbinals; a deep network with larger meshes is in the remaining portion of the lateral wall. The efferent trunks converge in a fossa placed between the Eustachian tube and the posterior ends of the turbinals. In the nares there is a network independent of the preceding, the efferent trunks of which run parallel to the facial artery.

NERVES.—The trigeminal (branches of the ophthalmic nerve and of the spheno-palatine ganglion) innervates the respiratory region. The branches of the spheno-palatine ganglion are the vaso-dilators of the nasal mucosa.

The olfactory nerve, divided into numerous branches, is distributed to the olfactory mucosa, and we know its relations with the epithelial cells of this region. Its branches pass into the nasal fossae through the cribriform plate of the ethmoid. They are covered by prolongations, in the form of sheaths, of the coverings of the brain, which accompany them into the mucosa. It is a true nerve center placed at the periphery.

The olfactory cells are nerve cells derived directly from the ectodermic cells. Their protoplasmic prolongations form the olfactory cilia; the prolongation of the axis cylinder is a fibre of the olfactory nerve. It goes to form the connection with the protoplasmic prolongation of the interpolated neuron, the cellular body of which lies in the olfactory bulb. This last establishes the relations with the cerebral centres.

The central olfactory nerve apparatus varies according to the osmatic power of the animal, and this depends upon the olfactory bulb with its convolutions. According to Zuckerkandl, the following organs are reduced in animals with rudimentary olfactory lobes and in man: the gyrus hippocampi, the lobe of the corpus callosum in the region of the isthmus and the fold of the retrolymbic passage, the convolution of the corpus callosum, the anterior perforated lamina, the horn of Ammon, the external marginal convolution, and finally the internal marginal arc. In the dolphin, which is truly an anosmotic animal, in opposition to the preceding, which are microsmatic, the brain presents: complete absence of the olfactory lobe, a decided regression of the basal portion of the lymbic lobe, complete absence of the anterior perforated lamina, reduction of the horn of Ammon to an extremely faint rudiment, complete absence of the fimbria, and a considerable regression of the external marginal arc.

CHAPTER II.

EMBRYOLOGY.

Amphioxus.

Hatschek (1884) asserts that the ciliated fossa corresponds to an ectodermic recess in which the anterior neuropore opens; it persists for some time without closing. The depression is united with an evagination of the left intestinal diverticulum which fuses with it. Thus constituted, the olfactory organ of Amphioxus represents two organs of Craniata: the olfactory organ and the hypophysis.

In this last homology, Hatschek finds a difficulty in the entodermic establishment of the hypophysal tube in Amphioxus.

According to Dohrn, the anterior primitive olfactory invagination becomes dorsal by the extraordinary development of the upper lip.

Willey considers the ciliated fossa of Kölliker as the homologue of the hypophysis of Craniata.

According to Kupffer this fossa corresponds to the median olfactory plate of the embryo of Acipenser. Amphioxus is the only primitive monorrhinal vertebrate.

Legros (1897) has extensively studied the morphology of the head of Amphioxus. The stomodeal fossa is, at the beginning, a large cavity (preoral fossa) which is separated into two parts by a fold of the entoderm. The antero-superior portion gives origin anteriorly and to the right, to a short diverticulum, the fossa of Hatschek, which is directed forwards; behind and to the left, to a narrower diverticulum, the nephridium of Hatschek, which is directed backwards. These two organs are the respective homologues of the olfactory fossa and of Rathke's pocket of the Craniata. Kölliker's fossa represents the portion of the ectoderm which corresponds to the neuropore of the embryos of Craniata. But it is not, as claimed by Hatschek and Willey, the homologue of the hypophysis of Craniata.

Fish.

1. Cyclostomes.

The study of the morphology of the olfactory apparatus shows a great difference between the cyclostomes and the other vertebrates; it is the monorrhinals against the amphirrhinals. This anomaly exists during embryonic life, even from the beginning of their development.

Historical.—Scott (1882), contrary to Calberla, describes the primitive imparity of the olfactory outline. This appears as a slight depression above the mouth—the common invagination of the nasal fossa and the hypophysis. The ectoderm, simply thickened at first, has very high cells; then, when the fossa is formed, those at the bottom are increased in height, while those of the opposite walls remain very low.

Kupffer (1894) was concerned in demonstrating the primitive amphirrhinal character of the Monorrhina and found two series of plakodes on the head; a dorsolateral and an epibronchial series. The two series converge anteriorly upon a terminal anterior plakode, which exists in the amphirrhina as well as in the Monorrhina. But in the Monorrhina it is invaginated, becoming a groove. At the passage which it forms there is a point of continuity between the brain, before its complete isolation, and the ectoderm.

In Petromyzon larva of 3.5 to 4 mm. in length, a fibrillary cord is found, destined soon to disappear, which unites the summit of the olfactory sac to the single olfactory lobe.

This disappears, and paired olfactory nerves are formed, which, without doubt, are homologous with those of Amphirrhina. But these paired nerves correspond to a single olfactory sac.

Calberla had alreay expressed the opinion that these nerves, which come from two symmetrical halves, are an index of the duplex character of the nasal organ.

Kupffer, from the standpoint of the single plakode, finds paired plakodes which are at first feebly developed and distinctly separated from the terminal plakode. Invaginations, which are produced and prolonged from them, are utilized for the formation of the olfactory sac. These paired portions affect the duplex character of the olfactory nerve in Petro-

myzon. No difference exists between the Monorrhina and the Amphirrhina.

Wilhelm Lubosch (1902), in Ammocetes of the eighth day, found the brain completely detached from the ectoderm. At the passage where the last point of union existed, the ectoderm was thickened and formed a single olfactory plate. On the 12th day a groove appeared in this olfactory lamina. Between this thickening and the hypophysal plate, an intermediate plate was found. This lies lower and permits the olfactory plate to project.

In the myxinoids, Kupffer found as the olfactory beginning a median plakode, placed ventrally in relation to the orifice of the neuropore. The final development does not differ from that in the Petromyzon. However, in place of terminating in a cul-de-sac, the cavity opens on the roof of the digestive cavity and communicates with it.

According to Götte, this canal of the Monorrhina is conserved in the Amphirrhina under the form of the cerebral prolongation, called the hypophysis; but Dohrn separated the two formations from one another.

Observations.—We have studied some young stages of Petromyzon planeri of 2 to 6 mm., but we have not been able to conclude our series. The nerve tube is well outlined in embryos of 4 to 6 mm. On its anterior extremity, it is in relation with a thick cellular mass, which, moreover, is connected with the ectoderm. This is the single plakode of Kupffer. On transverse and frontal sections, we have not seen the lateral thickenings of the ectoderm in connection with the single epithelial mass. Thus we find in the cyclostomes and in Amphioxus an olfactory beginning different from that of other mammals.

This same observation has been made by Scott and Wilhelm Lubosch, who describe only a single outline.

This is not the opinion of Kupffer, who describes three plakodes as the primordial olfactory outline in vertebrates.

Amphioxus, according to him, is the only one to possess a single plakode; all the others have a single plakode and paired plakodes.

Thus, in the Monorrhina (cyclostomes), the single plakode plays a great role in the formation of the olfactory organ, the

others taking little part in the extension and becoming fused to the first.

On the contrary, in Amphirrina (gnasthostomes), the single plakode is visible only during a short period of development.

However, Kupffer represents the single plakode as present in Acipenser, Acanthias, frog and sheep.

But many observers contradict this. In the figure of Acanthias by Miss Platt there is no local thickening of the horny layer and no plakode. The ectoderm in the anterior region of the head is almost wholly thickened and the opinion of Kupffer is not verified (Karl Peter).

In the amphibians, Götte describes a median thickening which he considers as the outline of the hypophysis. Corning and Hinsberg thought that this thickening was a frontal ray.

In birds, Van Wijhe did not find any median thickening.

Peter (1901), in the lizard, found a thickening upon the ventral portion of the lips of the neuropore, but this thickening did not have in its structure any characteristics of the sensory plakode; besides, it was never in relation with the lateral olfactory region. Moreover, it appeared in its formation to be related to a mechanical cause, as it is found at the place where certain organs (crystalline lens, auditory vesicle) are detached from the ectoderm; there is, therefore, no special significance in its formation at the level of the anterior cerebral vesicle. Karl Peter, on the other hand, denies the existence of this median ectodermic thickening in mammals.

Two facts, only, remain in favor of the primitive parity of the nasal organs of the cyclostomes: the duplex nature of the olfactory nerve, announced by Calberla, and the presence of a median septum, presented by Langerhans in support of this idea.

We have very distinctly observed the existence of two olfactory nerves in Ammocetes (see Morphology, Fig. 3) and the presence of a median septum (Fig. 2). It is, therefore, necessary to admit that two distinct areas give origin by their precocious fusion to the formation of the median single thickening. The mesoderm is only interposed between the two olfactory fields, as in the other vertebrates. The primitive dorsal situation of the areas favors this evolution.

In résumé, the Monorrhina are vertebrates with dorsal olfactory anlage, while in all the other groups we will see that it is primarily ventral.

The origin of the hypophysal diverticulum is due to the neuroporal thickening, according to Götte, Scott, v. Wijhe (1884, 1886) and Wiedersheim (1902). The naso-palatine canal in lampreys and mixinoids appears to correspond more to this nerve formation than to the choanal canal of air-breathing vertebrates.

Selachians.

Historical.—Balfour (1878), in his monograph on Elasmobranchia, speaks of the first appearance of the olfactory organ as a double thickening of the ventral epiblast. Milnes Marshall (1879) found a pair of thickenings of the external layer, below the surface of the anterior brain and immediately above the mouth. Each thick point evolved as a fossa; the bottom of this is very close to the brain. Ziegler indicates also the olfactory area. Holm (1894), in the torpedo, showed the origin of the olfactory organ depending upon ectodermic thickenings, placed laterally in relation to the neuropore. They are united to the brain by a cellular cord formed of elongated elements, while those which constitute them are formed of round embryonic cells. The brain, which is separated from the thick ectodermic zone, retracts and leaves it, and forms an olfactory nerve or ganglion. Hoffman (1896) indicates the zone of fusion between the anterior extremity of the medullary tube and the epidermis as the point of departure of the olfactory outline. Above the neuropore, this point of fusion is absorbed in part, but it persists as bridges of delicate plasma, at the place where the olfactory nerves are formed. In young embryos, the beginnings of the olfactory nerve are very close to one another, then they separate. The olfactory nerves can be well seen in an embryo of 13.5 to 14 mm. Up to this period, the olfactory groove lies close to the medullary wall. Mesenchymatous tissue is interposed between these two formations, and the olfactory nerve is increased in length in embryos from 18 to 20 mm. At the same time the groove is deepened. The borders of the groove approximate in embryos of 22 mm. and in embryos of from 27 to 28 mm. the base of the groove begins to be provided with folds.

Kurt Berliner (1902) published a long work on the development of the olfactory organ of selachians. He examined some embryos of Acanthias, Pristiurus and Spinax niger.

The olfactory beginning appears in Acanthias of 3 mm. length. In a Pristiurus of 5 mm. the outline is represented by a cellular plate of two or three layers. The ectodermic condensations have no relation with the neuropore; there is no possibility of a monorrhinal beginning, according to the idea of Kupffer. The olfactory plates increase by cellular multiplication, and it is the deep sensorial layer which alone enters into this development.

There is an invagination which increases progressively in depth and forms a cul-de-sac. Its borders are constituted by two cutaneous cushions. The olfactory organ, at first in the neighborhood of the neuropore (Acanthias of 3 mm.), is directed more and more towards the ventral side, and always retains this situation. The formation of cutaneous folds is due to an active proliferation of the indifferent ectoderm in the neighborhood of the olfactory organ.

The ridges of the mucosa, or folds of Schneider, appear in Acanthias at the stage of 25 mm. of length. Their formation appears to be due to the spontaneous multiplication of the internal wall of the sensory groove, rather than to the pressure of the mesodermic tissue.

Description of Stages.—We have examined a series of embryos of Pristiurus in the youngest stages, from 2 mm. in length, and some specimens of Scyllium canicula from 3 to 3.5 cm.

Pristiurus Melanostomus, 3 *mm. in length* —The central nervous system is represented by an elliptical tube, flattened laterally, with walls of regular thickness formed of round cells crowded against one another. The ectoderm is formed by several layers of round cells. The optic vesicle is present, and is placed behind and below the nervous system. There is no trace of the olfactory anlage.

7 *mm. in length* (Fig. 24).—The nervous system is a tube of very large lumen with slightly thickened walls. The optic vesicle is well developed. Below this, and at the level of the latero-ventral part of the nervous tube, the ectoderm presents a considerable thickness very much extended in the dorso-ventral direction. The thickness has the form of a disc, the borders of which are confounded gradually with the surrounding ectoderm. This is the olfactory anlage, which is composed of very small round cells. The central region of the

disc is slightly depressed and is of maximum thickness. The nuclei of the most superficial layer are far removed from the surface, so that the outline is bordered posteriorly by a layer of clear, finely granular protoplasm.

12 *millimeters* (Fig. 25).—The nervous tube and the optic vesicle have attained a high degree of development. The ectoderm is composed of several layers in regular order. The mesenchyme below the ventral surface of the nervous system is more compact, and surrounds an elliptical mass composed of round cells analogous to those of the ectoderm. A very large

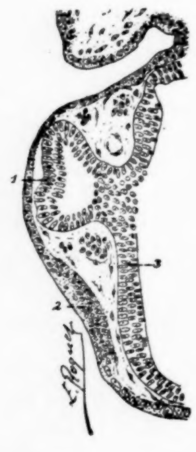


Fig. 24—X 95. Pristiurus melanostomus 7 mm. (right side). 1. Eye; 2. Olfactory outline; 3. Central nervous system.

cavity occupies the center of this mass, thus transformed into a vesicle, as seen in transverse section, passing 40 mikra behind the preceding. The cells which border the lumen of this vesicle present the same characteristics as those which lie at the surface of the olfactory outline in the 7 mm. stage; their central part is clear and they are of cubical form. This cavity changes in form and becomes more irregular in proportion as we approach the posterior regions, situated at a

distance of 140 mikra from the anterior extremity. The ventral surface penetrates into the cavity under the form of a conical ridge, and at each of the antero-external and postero-external extremities, the epithelium rises in very low folds, into the interior of which the mesenchymatous cells are insinuated.

Behind and above the ridge of the ventral wall, a large epi-

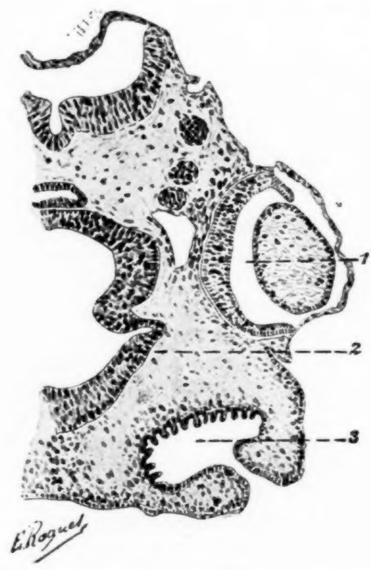


Fig. 25—X 34.3. Pristiurus melanostomus, 12 mm. long (appearance of lamellae in the olfactory cavity; left side). 1. Eye; 2. Nervous system; 3. Olfactory cavity.

thelial tract unites the vesicle with the ectoderm. Behind this epithelial tract, the vesicle communicates freely with the exterior. This orifice is limited by the borders of the primitive fossa. It is narrow, and it forms a sort of canal of an average height of 170 mikra. At this level, which is almost the middle region of the olfactory cavity, the epithelial folds are very numerous and occupy a very large portion of the bottom

of the cavity. In the most posterior sections (Fig. 25), the entire bottom is found occupied by folds, the height of which varies from 30 to 60 mikra, and which are separated from one another by plainly visible, deep fissures. The external orifice of the olfactory cavity is opened at the level of the border of the head, upon the ventral surface.

A little behind, the groove is less deep and opens freely externally, its borders not being limited by the canal. The walls are simple and without folds. Then, behind the groove, lies a slight depression, at the edge of which the ectoderm is unmodified.

The buccal depression begins a short distance behind the olfactory cavities.

In the regions where no folds exist the epithelial cells have still the embryonic character, while they lose it at the level of the folds, where they are more elongated, but still without a well defined form.

22 *Millimeters.*—As in the preceding stage, the olfactory outline begins anteriorly by a solid cellular mass. At the center of this the cells converge by their clear, finely granular extremities. The cavity appears in this cellular mass 110 mikra behind. The cavity in frontal sections is seen closed over an extent of 50 mikra, and then it opens externally by a large orifice. In passing from before backward, the fossa is enlarged and becomes less and less deep, its borders becoming attenuated and confounded with the neighboring ectoderm. Our frontal sections do not manifest any folds of the epithelial wall.

The cells of the superficial layer are quite cylindrical, and have an average height of 24 mikra. Their central portion is finely granular and clear, their color is rose gray (colored by alum carmine), while the peripheral portion is deepened and contains a strongly colored nucleus.

The nasal organ has not undergone displacement towards the lateral surface of the head; it is always situated under the infero-external border of the central nervous system. There is still no trace of cartilaginous skeleton.

SCYLLIUM CANICULA, 30 *Millimeters* (Fig. 26).—The external forms are those of the adult animal; the nasal orifices are hollowed upon the ventral surface of the head, anterior to the buccal opening, and are placed at a level anterior to

that of the eye. The nervous system is completely developed; below the ventral surface of the anterior cerebral vesicle, in the midst of the mesenchyme, is seen a series of small cavities elongated in a dorso-ventral direction, constituting the anterior extremity of the olfactory apparatus. These cavities are increased upon more posterior sections, and are finally united to form a single cavity. The common portion is extended transversely and the preceding cavities run vertically. The walls

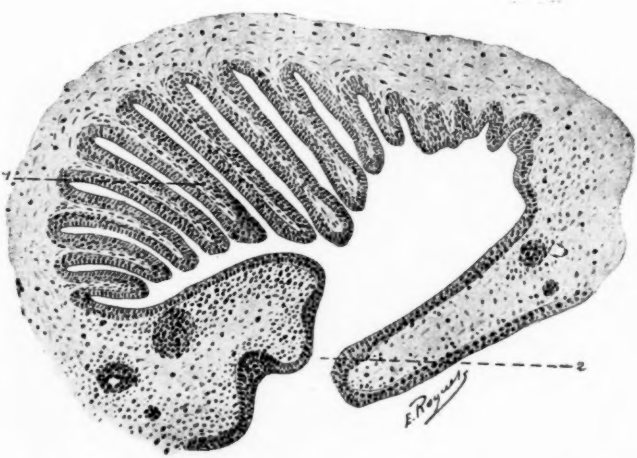


Fig. 26—X 70. Scyllium canicula (transverse section showing the lamellae inserted on the dorsal wall of the nasal cavity; right side). 1. Lamellae; 2. Nasal orifice.

which separate these cavities are nothing more than epithelial folds which have become higher and transformed into large lamellae.

A large cartilaginous tract, placed transversely, separates the ventral surface of this cavity from the ectoderm.

In the external third of the cavity, a large epithelial cord unites this wall with the ectoderm, and posterior to this the cavity opens externally (Fig. 26).

The nasal opening is contracted on account of the development of its borders, which approach one another and limit it into a narrow slit only 35 mikra wide at the point of greatest contraction. They are in the same plane as the ventral surface of the head. At a more posterior level, the borders of the groove limit an irregular canal with thin epithelial walls, which run obliquely into the nasal cavity. This is prolonged posteriorly from the orifice of entrance and is arranged as above.

The cartilaginous capsule is quite incomplete, only a portion of the ventral and dorsal walls being present. There is a trace of the septum.

The epithelium at the level of the ventral wall, and upon the border of the canal of entrance, is formed of round or cubical cells crowded together, and arranged in two or three layers. The lamellae, which are inserted perpendicularly upon the dorsal wall of the cavity, have a height varying from 178 to 500 mikra. At the level of the lamellae, and in the bottom of the grooves which separate them, the epithelial layer presents a superficial stratum of cylindrical cells. The axis of the lamellae is formed by the mesenchyme, composed of fusiform same as mesenchyme cells. The posterior portion of the nasal cavity is subjacent to the bulbus oculi.

Olfactory Beginning.—The olfactory organ appears in a very early stage in the selachians. Ziegler found it in the torpedo 3 mm. long; Balfour in Pristiurus and Scyllium of 6.5 mm.; Berliner in Acanthias of 3 mm. and Pristiurus of 5 mm.

We find in Pristiurus of the 7 mm. stage a very extensive olfactory outline, under the form of ectodermic thickening in several layers, occupying a large portion of the latero-ventral surface of the embryo.

This outline has been found by Holm and Hoffmann under the lateral portions of the ectodermic thickening of the neuropore.

Milnes Marshall (1879), Ziegler and Berliner (1902) found the outline placed below the central nervous system.

This ventral situation, or, more exactly, latero-ventral, can be well seen in Fig. 25; it remains during the stages of evolution.

According to Berliner, the olfactory outline is constituted by the multiplication of the deep or sensory layer of the cells of the ectoderm. Our observations indicate that the entire

thickness of this layer is indifferently employed in the development of the nasal thickening. In fact, the most superficial cells of the outline of the stage of 7 mm. present the characteristics which we find later in the cells which limit the olfactory cavity (Fig. 24). These are the cells of the surface which border the depression or olfactory fossette, and at a stage somewhat advanced, the cavity results from the union of the borders of the groove.

Moreover, at no point of the ectoderm is it possible to distinguish two morphologically different layers.

Evolution of the Olfactory Organ.—The surface of the olfactory plate is grooved, and, by virtue of the continued deepening, it becomes a deep cul-de-sac. This last is surrounded on all sides by thick ectoderm. Anteriorly, the cellular mass grows into the mesenchyme, and the cavity is enlarged so as to form a sort of vesicle. The depth of this cavity presents a series of folds of the epithelial wall, into the center of which the mesenchymatous cells penetrate. These folds, which are the outlines of the folds of Schneider, appear in Pristiurus of the 12 mm. stage; Berliner finds them in Acanthias of 25 mm.

From the time when the modifications of the epithelium appear, it is cylindrical at the level of the superficial layer of the folds, at the intermediate grooves in the 12 mm. stage, and at the orifice of entrance. The borders of the latter are elongated under the form of thick ridges converging in such a manner that the external border is concealed by the internal border; the external nasal orifice, instead of opening largely externally, is found transformed into a narrow and oblique canal.

Berliner (1902) shows, with great detail, the role played in the development of the nasal cavity by the multiplication of the cells in the olfactory outline and the elevation of the indifferent ectoderm.

It is to the cellular multiplication of the olfactory thickening that he accords the primordial role. The edges of the groove are developed, not in order to increase the cavity, but to increase the ventral wall and accordingly to narrow the external opening.

The olfactory organ, situated ventrally in the beginning of its appearance, holds this situation and is always found anterior to the buccal cavity.

III. Teleosts.

Historical.—His, Hoffmann, Holm and Kopsch studied the olfactory apparatus in Salmonidae family, Balfour and Parker in Lepidosteus, Kerr and Semon in the Dipnoi.

The organ begins as a thickening of the ectoderm placed on the ventral surface of the embryo, in front of the eye. According to Holm (1894) the cells of this outline are distinguished at an early stage from the neighboring embryonic cells by their elongated form. This writer studied the connection of the olfactory nerve lobe with the ectodermic thickening and assisted in the understanding of the olfactory nerve by separating its two formations. The organ begins in the salmon (Salmo salar) from the 28th to the 30th day. Kopsch (1898) recognized its first appearance in the trout at the stage of eighteen primordial segments.

The ectoderm being composed of two layers, the deep layer alone gives origin to the olfactory plates, and the superficial layer passes above their rudiments but does not participate in their formation any more than it participates in the formation of the crystalline lens and the auditory vesicle. Three processes are involved in the changes taking place in the olfactory organ: the growth of the organ, the modifications in the surrounding epidermis, and the changes in the sensory epithelium itself.

The organ is displaced from the ventral to the dorsal side. At first it is placed below the eye, later, anterior to it. On both sides of the groove are developed two prolongations, which confine at first the nasal orifice, then by fusion give rise to the two orifices. While the posterior orifice remains simple, the anterior becomes a long canal which, according to His, is formed by two median folds.

Balfour and Parker in Lepidosteus show the beginning of the olfactory organ as a marked thickening of the sensory layer without participation of the superficial.

Semon finds, in Ceratodus, ridges dividing the olfactory grooves, directed towards the buccal cavity. One of the orifices of the nasal cavity will sink into the buccal region—it is the first step towards the adaptation of the nasal cavity to the respiratory function.

Our investigations were made on the salmon trout, and on the rainbow trout for older stages. There is considerable dif-

ference in the duration of the evolution of these two species. At Clermont, the eggs of the salmon trout, placed in running water at 9°, are hatched in sixty days. At Pointis-Inard, at the home of our friend, Dr. Cardeilhac, the rainbow trout was developed in thirty days in water of 14°; thus, the specimens of one and two months which we have examined correspond to the much older stage of the salmon trout.

STAGES OF DEVELOPMENT.—*Salmo trutta—22nd day* (After fecundation.)—The external covering, well developed, presents several layers of cells, but it is impossible to distinguish two different strata. The interior of the embryo is occupied

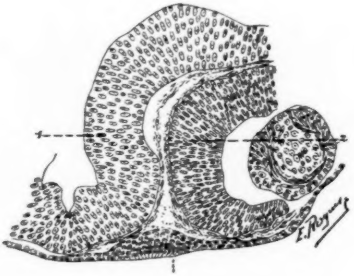


Fig. 27—X 70. Egg of salmon trout, 34 days after fecundation (olfactory outline presenting differentiation of the cells of the superficial ectodermic layer; left side). 1. Nervous system; 2. Eye; 3. Olfactory outline.

by agglomerated round cells without differentiation, and by the outline of the nerve tube. There is no optic vesicle or olfactory field.

34th day (Fig. 27).—The optic vesicle is large and well-formed and the neural tube is of large dimensions. The inferior surface of these formations is very close to the ventral ectoderm. In the short space between the optic vesicle and neural tube, the ectoderm shows a thickening in the form of a disc (Fig. 27). This is the olfactory anlage, its transverse extent is 285 mikra and its thickness 57. The superficial cells, at this level, have already undergone differentiation; they take

on a cubical or cylindrical form, and their protoplasm is similar to that of the embryonic cells.

52nd day.—The anterior part of the outline is a simple ventral thickening of the ectoderm; the cells which constitute it are elongated, perpendicular to the surface and distinguished easily from the adjacent ectodermic cells. No distinction is possible between the superficial and deep layers—the entire thickness of the ectoderm is concerned. A little posterior, the surface of the outline is depressed into a fossette and this grows, taking the form of a vesicle at a more posterior level. Then the mass becomes solid and is separated from the corresponding ectoderm. The buccal fossette does not correspond to the region of the olfactory outline, but is shown only a little more behind. The olfactory cavity lies between the optic vesicle and the lateral wall of the neural tube.

55th day.—There is little difference from the preceding stage; the olfactory vesicle is a little larger, its walls are uniformly thick. The length of the solid olfactory mass which prolongs the cavity is very considerable, and the ectodermic covering is detached for a greater length.

3rd day (after hatching).—No modification up to this time. The olfactory organ, which is always ventral, is placed on a transverse plane anterior to that of the eyes.

9th day.—The lumen of the nasal cavity is enlarged; the cartilaginous skeleton makes its appearance. The nasal organ begins to be directed towards the lateral surface of the embryo.

30th day (Fig. 28).—The nasal cavity is placed somewhat towards the middle of the lateral surface; it has the form of a simple pit, 100 mikra in extent from its anterior extremity. The borders which limit it are considerably elevated, due to the increase of the indifferent ectoderm. The cavity is closed and of cylindrical shape, with a length of about 70 mikra, then, behind, it is prolonged by a solid cellular mass. The epithelium which covers the bottom and the lateral walls of the fossette, and further the entire cavity, presents a superficial layer of cylindrical, much elongated cells. The buccal cavity has advanced to the region of the olfactory organ; the ventral wall of the latter is about 280 mikra distant from the buccal roof.

The cartilaginous skeleton has acquired a great development and has the form of an X on transverse section. An inferior branch separates the organ from the buccal roof, the superior branch separates it from the central nervous system and the

point of union of the four branches forms a sort of median septum some distance from each olfactory cavity (Fig. 28). The optic vesicle is in relation with the posterior extremity of the nasal apparatus behind which it is situated.

30th day (Fig. 29).—The body of the animal has the form of the adult. The olfactory cavity opens on the dorsal surface by a large orifice (172 mikra transversely), and it lies on the anterior extremity of the olfactory organ, the solid cellular

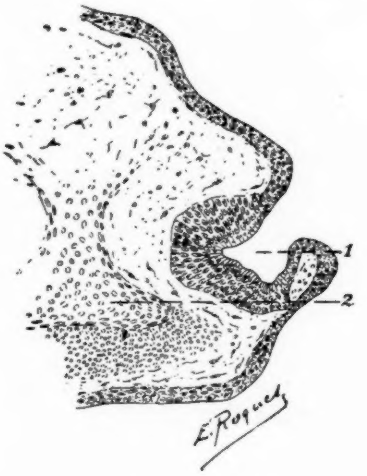


Fig 28—X 68.5. Salmon trout, 30 days after hatching (olfactory fossette presenting differentiated sensory cells throughout; left side). 1. Olfactory fossette; 2. Outline of cartilaginous skeleton.

mass which existed in the preceding stages, being distinctly hollow. The ventral wall makes a projection into the cavity under the form of a thick fold, 228 mikra at the base and 321 mikra high across its middle portion. This ventral fold lies only in the opened portion; behind the nasal orifice, the lateral walls have each a narrow, slightly elevated fold. The epithelium is thick throughout the ventral wall and the fold comprised by it; it is thin over the lateral and superior walls.

2 months.—The nasal sac has an irregular, triangular form; its walls sink into the cavity. A very long fold lies on the internal wall at the level of the external orifice. Behind, the folds are numerous (3 or 4 depending on the section considered); they are all inserted along the bottom of the cavity. Their folds or lamellae have the structure which we have described in the adult. The dorsal situation of the nasal organ is definitely acquired; it is entirely in front of the eye.

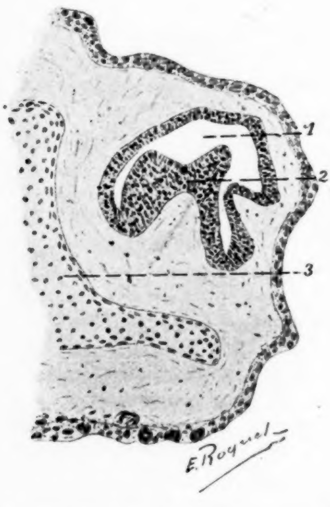


Fig. 29—X 68.5. Rainbow trout, 30 days after hatching (olfactory cavity presenting ventral folds with the outline of the lamellae; left side). 1. Nasal cavity; 2. Folds of ventral surface; 3. Cartilage.

A bony arrangement separates it from the buccal cavity, from which it is henceforth very far removed.

Evolution of the Olfactory Organ.—The olfactory apparatus is exceedingly simple, a solid outline which is transformed into a pit and vesicle. Its origin from the ectoderm is very well marked by the differentiation of the epithelial cells in this region. We have been unable in any stage to

distinguish, at the level of the ectodermic thickening, the superficial epithelial layer from the remainder of the ectoderm. This layer appears concerned in its entire thickness in the development of the nasal anlage. The increase in size of the cavity and its displacement towards the dorsal surface are the principal transformations. At an advanced stage, the wall is raised and forms the lamellae, which are better developed in the adult. There is no trace of glands or of diverticula in the cavity. Madrid Moveno (1887) has studied the histologic transformations of the nasal mucosa in a series of fishes having the olfactory buds described by Sophie Pereyaslawzeff and Blaue. (Belone, Trigla hirundo, Zoerus vivaparus, Cyprinodon caloritanus.)

A disc of homogeneous sensory epithelium is primitively in the bottom of the olfactory fossette.

Soon an islet of pavement epithelium appears in the middle of the disc; this later becomes a fold. Other islets are established, extend and unite with one another in such a manner as to divide the olfactory epithelium into small fields. These olfactory fields, more or less small and numerous, are composed of supporting and sensory cells.

The neighboring pavement epithelium surrounds them in such a way that they communicate with the exterior only by a narrow orifice.

In fish such as the trout, eel, perch, etc., in which the epithelium is deprived of olfactory buds, the modification of the epithelium consists mainly in the appearance of folds, such as Kopsch has observed in the trout.

The olfactory fossette, on the 52nd day of incubation, is covered with long cells which circumscribe the lumen, while the deep cells preserve the characteristics of round embryonal cells. The differentiation of the round cells is extended throughout the groove. In the posterior region, where the olfactory outline is represented by a small vesicle with thick walls, the differentiation does not extend to the external wall of the vesicle.

On the ninth day after hatching, the long olfactory cells do not occupy a large portion of the olfactory cavity; the external portion only is covered with round cells.

The disposition of the elements is still the same on the 30th day in the salmon trout (Fig. 28). On the 30th day folds may be seen on transverse section, passing through the middle of

the vesicle (Fig. 29) in the rainbow trout. The whole internal portion, folds and intervals, and a portion of the dorsal and ventral wall present a very thick epithelium with superficial, long, cylindrical cells. The other portions of the cavity are covered with epithelial cells, round in the bottom and flat towards the lumen. This arrangement remains definite.

The enlargement of the olfactory cavity, after the ninth day, results not only from the multiplication of the cells of the olfactory mass and their membranous disposition to cover the fossette of invagination but also from the growth of the borders of the fossette, which are only welded together after forming extensive folds.

Amphibia.

HISTORICAL.—Born, Burckhardt, Seydel, Bawden, Brauer and Sarazin studied the evolution of the nasal cavity in old embryos.

Goette (1875) made a complete study of the series of stages in a remarkable work on the development of Bombinator.

He found the ectodermic cells, at the beginning of the development, arranged in two layers: the covering or superficial layer, and the sensory subjacent to it. The beginning of the olfactory organ is a thickening of the sensory lamina. On each side, this appears as a depression in front of the fore brain and below the inferior portion of the primitive optic vesicle. Portions of the middle layer are placed between the eye, the brain and the olfactory organ, but its situation remains lateral in relation to the anterior extremity of the brain. The external layer is invariably separated from the basal layer formed of cylindrical cells; soon they are fused into a single cellular mass, in such a way that the entire external coat forms the bottom of the olfactory organ. The ectoderm adjacent to the posterior border of the thick olfactory lamina is raised into a fold which increases the external wall of the nasal fossette, while the olfactory lamina forms the median wall. The superior portion of the olfactory cavity remains open, the bottom directed backward is narrowed in the form of a slit and is fused with the anterior portion of the buccal roof. The posterior orifice opens in this place.

In opposition to Rusconi and Van Bambecke, who claim that the whole nasal fossette forms the olfactory organ, Goette

considers only the thick part forming the median wall as the sensory organ.

Corning (1889) describes the two layers of ectoderm, the superficial and the nervous, and indicates in detail their individual characteristics.

The olfactory thickening is established as a medullary plate. At this level, the two layers of the ectoderm are at first distinct, then they are intermingled so that it is difficult to determine what part of the formation is derived from the superficial and what from the nervous layer.

The olfactory organ thus differs from the auditory, the crystalline lens and the organ of the lateral line.

The fusion of the two layers is already effected in embryos of 6 mm.

Strasser (1901) reports only the role of the mesoderm in the situation of the olfactory organs.

Hinsberg (1901, 1902) gives a long description touching all the stages of development of Anura, Urodela and Gymnophiona.

The olfactory thickening of Rana fusca comprehends only the sensory layer of the ectoderm, the superficial layer regressing at this level. The olfactory lamina increases its ventral portion and reaches the buccal epithelium. By the removal of the cells, a round lumen appears at the postero-superior pole of the olfactory lamina, as well as in the ventral prolongation, and then a communication is established between the buccal groove and the nasal lumen. The choana thus formed lies behind the vestige of the pharyngeal membrane, consequently in the ectodermic region of the buccal cavity.

The olfactory fossette, increased in dimensions, takes on a funnel-shaped form; it is continued posteriorly and internally by a canal terminating in a cul-de-sac. Ultimately the cul-de-sac enlarges, becoming the middle lumen.

En résumé, the nasal cavity is composed of three genetically different parts: 1. The dorsal lumen, a round canal situated at the superior pole of the olfactory lamina, covered on all sides by sensory epithelium. 2. A slit made by dehiscence, which forms across the ventral prolongation of the olfactory lamina and communicates with the buccal groove—the ventral lumen. 3. The middle lumen, constituted by the differences in growth between the olfactory lamina and the epidermis.

The ultimate changes at the neighborhood of the external

orifice consist in an increase in the length of the middle lumen, and a retraction of the orifice itself, which has an annular thickening on its circumference, having the function of a valve. The choana is modified by enlargement transversely.

Hinsberg does not attribute to the cul-de-sac the value of an organ of Jacobson, accorded to it by Born and Seydel.

The establishment of the middle lumen is simultaneous with the lachrymal opening and we must therefore think of a causal coincidence between these two facts. A large glandular conglomeration appears at the beginning of the metamorphosis on the lateral nasal wall, anterior to the lateral appendix. A second forms on the posterior border of the choana, corresponding to the pharyngeal gland of Born.

The formation and evolution of these different culs-de-sac have been studied at length by Hinsberg.

The beginning of the olfactory lamina in Urodela, as well as Anura, is a thickening of the sensory lamina; the disappearance of the superficial layer is also more distinctly recognizable. The primitive nasal cavity is more simply established; it increases longitudinally, while in Anura it increases dorsoventrally.

The lumen of the olfactory fossette corresponds to the middle lumen in Anura. The external orifice is displaced towards the lateral part by a sort of rotation of the axis of the nasal canal. On account of this rotation, the external cul-de-sac of the triton corresponds to the inferior cul-de-sac of the frog.

Hinsberg has studied the development of the olfactory apparatus in Gymnophiona, the first stages in Hypogeophis rostratus, the more advanced stages in Ichthyophis glutinosus.

The sensory lamina is still alone the site of thickening. While Brauer, insisting on the development of the external forms, finds a persistent groove between the lateral and median frontal buds, forming a slit between the mouth and the nasal cavity, Hinsberg has not observed a canal of this kind, but finds the naso-pharyngeal canal formed later into a cellular cord which at first was entirely solid. Nevertheless, by the formation of the choanae, Gymnophiona approach more nearly the Mammalia than any other Amphibia. Hinsberg also noted an inferior cul-de-sac, which had been described by Sarazin as an organ of Jacobson, but he does not accept the opinion of this writer.

Peter's (1902) article in Hertwig's work on comparative and

experimental embryology is principally based on the investigations of Hinsberg.

Description of the Stages.—We have examined two series of embryos, Bufo vulgaris from the 2.5 mm. stage to the complete disappearance of the tail, and Rana esculenta from 4 mm. to the beginning of the metamorphosis.

Bufo vulgaris.—*Tadpole 2.5 mm. in total length.*—The ectoderm is formed by several layers of cells pressed upon one another, all round and without regular disposition in the successive strata. The most superficial are filled with pigment, which forms a brown border, the pigmentation sinking in places and forming spots in the deep portion.

The ectoderm is very thick on the ventral surface of the embryo.

The nervous system is represented by a small tube with a thick wall detached from the ectoderm. A compact cellular mass fills up the remainder of the body. A separation exists between this mass and the external coat, marked by a circular fissure. There is no trace of sensory outline.

Tadpole of 3 mm.—The nervous system represented by a round tube with thick walls throughout its circumference; appearance of the optic outline, an evaginated vesicle of the neural tube, of which the walls are very thick anteriorly and posteriorly; no trace of olfactory outline.

Tadpole of 4 mm. (Fig. 30).—The ectoderm presents a strongly pigmented external border and a layer of round cells, between which short, pigmented cells extend. The nervous system is represented by a tube, very high on transverse section, with thick lateral walls. The buccal invagination is well-marked. The olfactory outline exists under the form of a thick zone projecting inwards from the ectoderm. The cellular multiplication is especially active at the level of the deep layer, but the pigmented cells constituting the superficial layer do not disappear at the level of the thickening.

The surface is slightly depressed on the anterior part of this olfactory zone. The olfactory outline is placed at the level of the latero-ventral angle of the neural tube. The middle and posterior part are subjacent to the cellular mass which becomes the optic vesicle (Fig. 30).

Tadpole of 6 mm.—The anterior extremity of the olfactory outline is a solid cellular mass, into which the ectodermic depression penetrates with an increasing growth from before backwards. The pigment is localized in the superficial layer but is found in the bottom of the depression.

The buccal invagination, which is large and deep, has a roof formed by a thick epithelial layer. The olfactory region, depressed into a fossette, has a length of 80 mikra; then its borders approach and limit a closed cavity. It has a narrow lumen, and its dorsal, internal and ventral walls have an

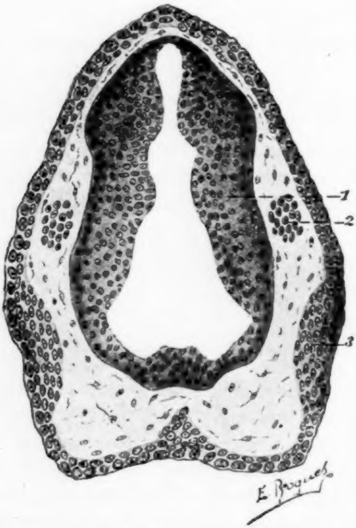


Fig. 30—X 95. Toad, tadpole, 4 mm. long. 1. Central nervous system; 2. Outline of the eye; 3. Olfactory outline.

average thickness of 70 mikra, while the external wall is only 14 mikra in thickness. Its ventral extremity is elongated towards the buccal epithelium, and the two walls, nasal and buccal, are fused to an extent of 40 mikra, antero-posteriorly. Behind, the nasal cavity, in the form of a fissure, opens into the buccal cavity, the first appearance of the choana.

There are to be recognized in the nasal walls pigment cells

which indicate well the participation of the superficial ectodermic layer in the olfactory development. Within the nasal cavity there are some cartilaginous intervals.

Tadpole of 7 mm.—The olfactory outline presents an anterior portion detached from the ectoderm. The nasal cavity is more prolonged posteriorly and the dorsal and internal walls attain a very great thickness. There is a very slight diverticulum of the external wall, which is very thin.

Tadpoles of 8 and 9.5 mm.—The olfactory outlines do not present any important modification.

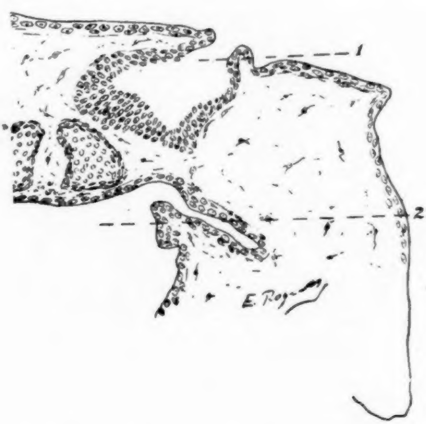


Fig. 31—X 68.5. Toad, tadpole, 13.5 mm. (left side). 1. Olfactory fossette; 2. Buccal cavity.

Tadpoles of 10 mm.—Olfactory mass very voluminous, lumen spacious, dorsal and lateral walls thick. The expansion of the cavity which penetrates the ventral cellular mass is large; the lateral diverticulum is of slight depth. Some cells of the internal wall are cubical, the nuclei are far removed from the surface and the protoplasm is clear.

Tadpole of 13.5 mm. (Figs. 31 and 32).—Anterior to the ectodermic depression corresponding to the olfactory fossette, the cellular mass which limits the bottom of it is prolonged as a cylindrical mass, isolated from the ectoderm for a distance

of 40 mikra. The olfactory fossette is of large dimensions, 250 mikra deep and 164 in width (Fig. 31). The opened portion extends antero-posteriorly 120 mikra, then the cavity is closed. The internal and ventral walls are very thick. The lumen is formed of two diverticula, one of small importance directed outward, the other directed downwards. The latter is arranged as in the stage of 6 mm. It increases in depth from before backward and opens into the buccal cavity (Fig. 32).

In its anterior part, the nasal cavity presents a lumen formed

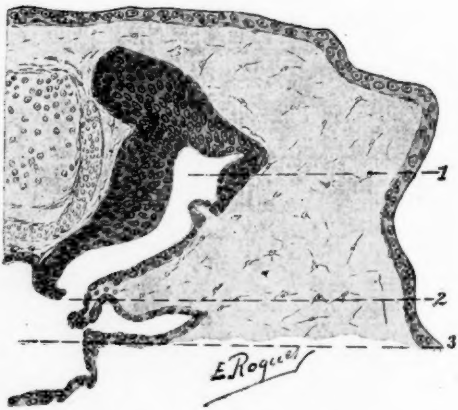


Fig. 32—X 68.5. Toad, tadpole, 13.5 mm. (transverse section of the posterior region of the nasal cavity, passing through the choana; left side). 1. Nasal lumen; 2. Choana; 3. Buccal cavity.

by an almost elliptical central portion and three diverticula; a dorsal, an external and a ventral. Behind, it is elongated dorso-ventrally and narrowed from above downwards. It is situated entirely in front of the eye, and its posterior extremity is in relation with the central nervous system.

Tadpole of 16 *mm.*—The dorsal region of the olfactory vesicle has undergone a transverse enlargement, which is represented in transverse sections by external and internal culs-de-sac. The nasal cavity is behind the choana, shown in an antero-

posterior direction. Over the whole internal wall there are long cells, some cylindrical, some cubical.

Tadpole of 20 mm.—The olfactory fossette appears to acquire a position more and more dorsal. The mass constituting the

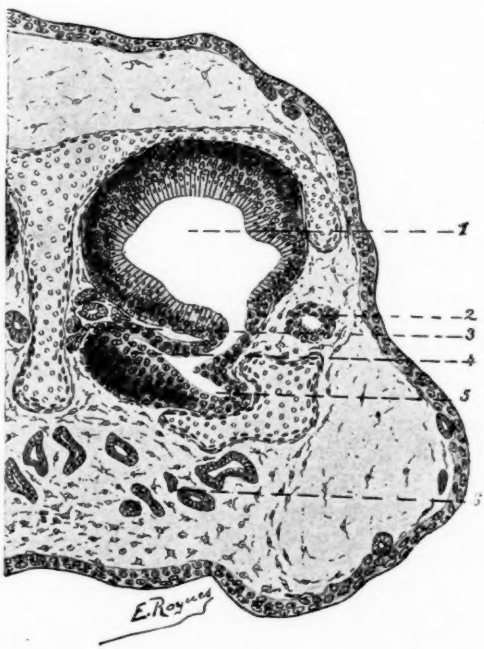


Fig. 33—X 68.5. Toad, tadpole, with four feet and a long tail (transverse section, showing the inferior cul-de-sac, glands and the lachrymal canal; left side). 1. Principal nasal cavity; 2. Lachrymal canal; 3. Gland of Jacobson; 4. Organ of Jacobson; 5. Infero-external cul-de-sac; 6. Palatal glands.

ventral prolongation is hollowed into a lumen by the simple removal of the cells at the level anterior to the choana.

The first differentiation is effected in this cellular mass while it is exclusively composed of round cells. Throughout the in-

ternal wall, the superficial cells elongate, become cylindrical and are arranged in regular layers.

Tadpole having four feet and a long tail. (Fig. 33) The nasal orifice is placed on the border of the dorsal surface of the cephalic region; it gives access to a deep fossette, the epithelial wall of which has a more regular thickness than in the preceding stages.

Behind the external opening, the cavity has an elliptical form in transverse sections, and it sends out an external diverticulum, of small importance. Its long axis is directed transversely.

The nasal cavity communicates through the middle of its ventral wall with a small cavity which is subjacent to it (Fig. 33). The orifice of communication is situated 250 mikra from the anterior extremity of the organ. It has an antero-posterior extent of about 80 mikra; traversely, its extent is increased as we pass backward. The inferior cavity, to which it gives access, is nothing but the ventral diverticulum seen in the preceding stages, which has acquired now a large expansion and a disposition approximating that of the adult. This diverticulum extends anterior to the orifice of communication for a distance of 120 mikra, and passes parallel to the ventral surface of the nasal cavity.

In the largest portion, the lumen of this diverticulum has a tranverse extent of 357 mikra. Its internal wall is much thicker. The canal, by which it communicates with the nasal cavity, opens at the middle of its superior wall. It has this disposition for a distance of 150 mikra and then it forms a large groove opening upwards into the nasal cavity. This enlarged portion ends in the choana.

The superficial cells have a cylindrical form throughout the nasal cavity, those of the dorsal and internal walls being the highest (from 57 to 71 mikra). In the vicinity of the ventral diverticulum, the cells gradually lose their height, becoming cubical and then flat. The epithelial investment of the inferior diverticulum has still the embryonal characteristics.

Numerous glandular culs-de-sac lie below the inferior diverticlum, throughout the transverse extent of the palatal vault. They are separated from the nasal organ by an incomplete cartilaginous lamina.

Others, less numerous, lie between the internal border of the inferior diverticulum and the nasal septum, and another group against the external wall of the nasal cavity.

In the middle of these last glandular tubes, the section of the lachrymal gland is distinguished (Fig. 33).

The glandular cells, of cubical form, have a basal extremity containing the nucleus, and a clear central extremity with homogenous contents; they appear to be of a mucous nature.

The metamorphosis comes to its end; the animal already adapted to amphibian existence, perfects the respiratory apparatus by the appearance of these glands.

We may see the relation of the olfactory apparatus to the neighboring organs, by a series of sagittal sections. It is always situated in front of and below the eye, and above the buccal roof. The length, dorso-ventrally, of the olfactory mass establishes the continuity between this mass and the buccal epithelium, then the nasal lumen discards the cells of inferior prolongation, the epithelium is resorbed and the communication is established. The antero-posterior extent of the nasal cavity and of its ventral diverticulum is inconsiderable; this latter appears destined to establish the bucco-pharyngeal communication. In a series of horizontal sections comprising all of the body of the embryo, we have seen that the choana opens into a true fossa of the buccal epithelium. In its middle portion, the nasal cavity is separated from the buccal region by a cartilaginous wall.

We see it open externally; at this level the cartilaginous wall of the cranium separates it from the nervous system. A little higher, an interruption in the cartilaginous capsule permits the passage of the olfactory nerves, which arising from the anterior pole of the anterior cerebral vesicle, already divided into two hemispheres by a sagittal groove, enters the internal wall of the olfactory vesicle at the level of its anterior third.

In a more dorsal section, the olfactory apparatus is represented only by a solid mass situated in front and only a very short distance from the brain. At this level, the eye seems far behind the olfactory mass.

Rana Esculenta. *Tadpole of* 4 *mm.* On the lateral surfaces of the cephalic region, there is a lightly depressed ectodermic zone; the entire thickness of the ectoderm is involved. At the level of the groove, the deep layer, composed of round cells, crowded upon one another, presents a distinct thickening, which is continued backwards and downwards into the mesenchyme. The neural tube exists, and the olfactory fossettes correspond to its latero-ventral surfaces. The buccal depression does not exist in this stage.

Stage of 5 to 9 mm. Evolution of the olfactory outline analogous to that of the toad. The choana is plainly shown in the 9 mm. stage; in the preceding stages, the lumen already penetrates into the ventral cellular mass and comes in contact with the buccal epithelium.

Tadpole with two feet. The spacious nasal cavity presents, anterior to the choanal region, three diverticula of large antero-posterior extent: one is directed externally and opens into the superior part of the cavity; another, directed internally and superiorly opens in the middle portion and is surrounded by a very thick epithelial wall; finally the inferior diverticulum ends in the choana. Numerous glandular culs-de-sac lie internal and below the internal diverticulum.

APPEARANCE OF THE OLFACTORY OUTLINE. Corning found the cells of the two indistinct ectodermic layers participating in the formation of the olfactory epithelium in an embryo of Rana fusca, 6 millimeters long.

Hinsberg observed the first condensation of the sensory layer in a tadpole of Rana fusca, 3 mm. long.

Our results in Rana esculenta and Bufo vulgaris are almost identical. The first traces of the olfactory mass appeared in tadpoles 4 mm. long.

It is a thickening of the ectoderm which represents the olfactory beginning; it is composed of a mass of round cells having the characteristics of the deep cells of this coat. The superficial pigmented cells preserve their characteristics at this level.

The ectodermic zone, thus modified, lies upon the lateral portions of the head on each side of the neural tube (Fig. 30); the buccal depression still does not exist at this period, but the eye is already formed; it is placed dorsally in relation to the posterior extremity of the olfactory mass.

EVOLUTION OF THE NASAL OUTLINE. During the first stages, the olfactory apparatus of the Amphibia appears as that of fishes; it is formed as a thickening of the ectoderm which is depressed into a fossette. This increases in depth and its borders approach by cellular multiplication, limiting a narrow orifice, the external nasal opening. The groove penetrates the cellular mass, the elements of which disappear, the internal and posterior walls alone remaining thick.

The lumen appears in the zone which results from the growth posterior to the nasal outline and which remains isolated

from the neighboring ectoderm, and at this level the nasal cavity has the appearance of a vesicle, isolated in the mesenchyme. The olfactory mass, hollowed in its middle portion, solid anteriorly and especially behind, approaches the buccal roof by its posterior extremity. It is situated below the eye and central nervous system. Up to this point there is no difference from animals breathing water exclusively. Little by little, the animal is prepared for air breathing; the olfactory mass is elongated in its ventral portion and forms a solid prolongation. Then a lumen appears in this latter—the ventral diverticulum.

The ventral prolongation joins the buccal epithelium and the diverticulum lengthens, the two cavities, buccal and nasal communicating with one another. First there is cell proliferation, then fissuration with removal of the cells appears, increases and ends finally with the formation of the choana.

The bucco-nasal relation is established by a peculiar, one might say, intrinsic process, without participation of the ectoderm as in Amniota, which have an external naso-buccal fossa or groove. Götte (1875) observed the beginning of this process in young specimens of the toad. Hinsberg (1901) could not find this process in Rana fusca and we have not seen any trace of it in the frog or toad.

Two processes must be admitted in the appearance of the nasal lumen: the ectodermic folds which limit the olfactory fossette and the hollowing of the olfactory mass by the removal and compression of the cells. We must not be exclusive as Götte, who attributes all importance to the first factor and as Hinsberg who accepts the second only.

The first process is concerned in the beginning, for the purpose of forming the superficial fossette in the thickness of the ectodermic mass and then, when the pigmented layer is indistinct, the second process is brought into play to increase the cavity, already acquired.

It is this process of fissuration which creates a lumen in the ventral bud. This latter becomes hollow from its anterior portion, and in the posterior region, where it unites with the buccal epithelium, it is completely perforated and constitutes the canal of communication between the two cavities. The lumen which exists anterior to the choana has the form of a groove, opening above into the nasal cavity. In old tadpoles, with four feet, this is only a simple groove, which is hollowed in its inferior prolongation—a diverticulum extended transversely.

This is evidently the inferior cul-de-sac of Born. We have, in the chapter on Morphology, shown the importance of the inferior cul-de-sac, which is a formation destined to increase the respiratory region. In a series of embryos, we have observed in fact that this inferior lumen appears by a hollowing in a cellular bud, which has no other purpose than to reach the buccal epithelium so as to establish bucco-nasal relations, and in consequence to open an air passage. And it is in the vicinity of this respiratory zone, which must be lubricated and moistened, that the first glandular formations appear.

The advanced stages have been well studied by Born in Pelobates fuscus and Rana fusca. He devotes a long description to the buds of the nasal cavity and to the diverticula which perforate them. These are superior, lateral and inferior; the superior corresponds to the true nasal cavity, the lateral receives the opening of the lachrymal canal and the inferior constitutes the maxillary cavity.

Hinsberg finds these culs-de-sac and insists upon their significance. He does not accept the opinion of Born with regard to the inferior cul-de-sac; it also appears to him difficult to consider it as the homologue of the organ of Jacobson, as Fleischer, Sarazin, Burckhardt (1891) and Seydel (1895) claim. The points of difference in the development and the later appearance in Amniota do not permit homology with this organ. But because of the sensory epithelium which this cul-de-sac contains, Hinsberg attributes to it the same functions as the organ of Jacobson. There is analogy but not homology between these two formations.

Besides, in the course of development, he observed "a lateral appendix" arising from the postero-superior wall, appear and disappear.

Our sections show the inferior diverticulum, and external to it a lateral diverticulum, which pushes into the region where the glandular evaginations of the external gland (superior of Born) are formed.

Evolution of the Nasal Cavity of Urodela and Gymnophiona. In these two groups, Hinsberg (1901, 1902) studied the beginning of the development. The olfactory outline is constituted, as in Anura, by a thickening of the ectoderm, localized in the sensory layer. Brauer observed in Gymnophiona the nasal apparatus begin in a very slight fossette of almost triangular form. The buds of the facial mass distinctly participate in the constitution of the olfactory apparatus.

Between the median and lateral frontal buds, a groove is gradually formed, which brings the nasal fossa in direct communication with the buccal cavity. The choana, by an earlier establishment, will utilize a naso-pharyngeal ectodermic canal in its constitution. According to the researches of Sarazin, there is, in the ventral portion of the cavity, a sensory epithelial mass which corresponds to the organ of Jacobson in form and location. Hinsberg found this diverticulum representing the inferior cul-de-sac in other Amphibia.

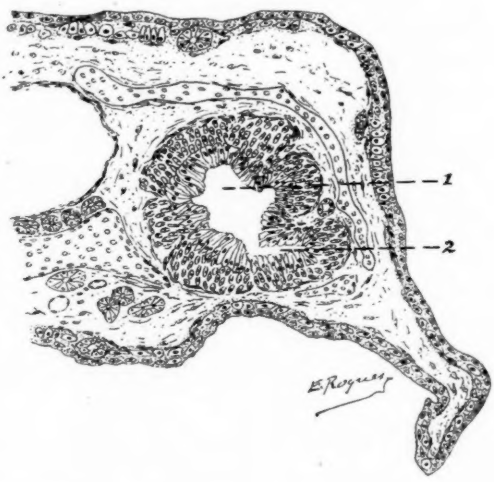


Fig. 34—X 68.5. Triton, still having branchia (transverse section, left side). 1. Nasal cavity; 2. External furrow.

The ectodermic thickening in Urodela appears more in the form of a button than in Anura, and the dorso-ventral addition does not exist. Hinsberg explains this difference by the form of the head and the location of the olfactory outline. The head is flatter, and the outline lies at the point of the anterior extremity of the buccal cavity, and not dorsally as in Anura. The increase in the direction of the axis of the body brings the primitive nasal cavity in contact with the buccal epithelium by removal of the mesoderm.

The caudal prolongation will be hollowed out of a lumen, like the ventral prolongation of Anura, and later the naso-buccal communication will appear. A cul-de-sac arises from the inferior wall, which ultimately acquires a lateral position by displacement of the axis of the nasal cavity; this is the inferior cul-de-sac. A slight evagination exists on the lateral wall which is to receive the lachrymal canal, but it remains in the state of a simple groove, while in Anura it forms the lateral cul-de-sac.

Burckhardt (1891), in old embryos, and Seydel (1850) and Born (1838), in the adult, homologized the inferior cul-de-sac with the same cul-de-sac of Anura and the organ of Jacobson of Mammalia.

We have been able to examine only the triton, in advanced stages of evolution, but still provided with gills. The external nasal orifice lies almost exactly in the middle of the lateral surface of the head, and corresponds to the anterior extremity of the nasal cavity. This has the form of a vesicle with thick walls, circular on transverse section; it opens into the buccal cavity by its posterior extremity. At this level, the ventral wall, very near to the buccal roof, is united to the latter; the nasal lumen penetrates into the zone of union and communication is established by a very simple process (Fig. 34).

The nasal lumen is prolonged radially by narrow diverticula or canaliculi which force away the constituting cells from the wall. Certain zones have the appearance of a cavity cut out by lamellae, as in fishes. At the level of the infero-external angle, the cavity sends out a lateral diverticulum which is hollowed into an evagination of the epithelial wall (Fig. 34). This diverticulum, which is very extensive antero-posteriorly, constitutes a groove enlarging the nasal cavity, and terminating behind in the choana. This is the inferior cul-de-sec of Born, Seydel and Burckhardt. It retains the same situation in the adult, and we have already indicated its functional significance.

REPTILES.

HISTORICAL. Rathke (1839) published a monograph on the development of the lizard; Parker (1879) studied the skull of the common snake; Born (1883) described the development of the nasal cavity of Lacerta agilis and Tropidonotus natrix. The beginning of the olfactory organ, as described by Rathke, is a small circular zone found on the ectoderm, under the cerebral hemispheres. A fossette is formed in this zone. External modifications are brought about by the development of the face (frontal and maxillary bud). A groove appears at the ventral extremity of the median wall of the nasal cavity in the stage of 47 intervertebral segments in the lizard; this is the first appearance of the organ of Jacobson. The external and internal nasal buds are formed at the expense of the frontal and approach one another; the point of the external nasal buds unites with the external surface of the internal nasal bud. Above this is only a punctiform orifice, which is the external nasal orifice. Below the bridge of fusion, the internal nasal orifice is formed and the bridge of fusion forms the primitive palate, which is increased in such a manner that it pushes the internal orifice more and more posteriorly. This transformation is well seen in Fig. 2, Pl. IX (1883).

Born (1883) gives a lengthy description of the formation of the palate; the superior maxillary bud sends out a median prolongation which unites with the septum except in its anterior portion, where the organ of Jacobson opens. These formations and their line of fusion extend backward, increasing the length of the palate and displacing the choana. The turbinal, a ridge which penetrates into the cavity, is formed on the external wall of the nasal cavity at the level of the maxillary bud. The formation of the lateral nasal gland, the relation of the lachrymal canal with the space subjacent to the turbinal, and the distribution of the sensory and stratified epithelium are the subjects of detailed study. Plates IX and X of his work (1883) show the relation of the different buds of the face and their changes as well as their orifices and the relation of the cavity with the organ of Jacobson.

Orr (1887) represents the olfactory beginning in the lizard as a thickening of the epiblast, which is gradually transfromed into a round depression.

Keibel (1893) deduced no conclusions from the study of a series of Anguis fragilis but agreed with those of Born, and admits that in important points there is analogy with mammals.

Voeltzkow describes, in the Madagascar crocodile, the formation of an olfactory cavity, as in the saurians. The differences lie mainly in the development of the palate. The palate prolongations are formed of large laminae which come in contact through the middle portion of their length; the palatal laminae and the pterygoid, behind, limit a long nasopharyngeal canal.

Meek (1893) describes, in the early stages of the Crocodilus porosus, the nasal cavity and its diverticula, particularly a closed groove of the internal wall, which is a vestige of the organ of Jacobson.

Sluiter (1892) and Röse (1893) in a series of young embryos of the crocodile, studied a cul-de-sac of the postero-inferior extremity of the nasal cavity, which they considered as the organ of Jacobson.

Seydel found the olfactory beginning in the turtle (Chrysemys picta), as a fossette, which is deepened and limited by nasal buds which are fused as in the lizard. It forms on the median wall a groove covered with olfactory cells, and separated by a projection of indifferent epithelium from the sensory epithelium situated above. Seydel compares it to the inferior cul-de-sac of Amphibia, and considers it the organ of Jacobson.

Karl Peter (1900), studying the development of the olfactory organ of the lizard, shows the part which should be accorded to the corrugation of the ectoderm and the predominant role played in the active development of the olfactory thickening by multiplication of the cells. The organ of Jacobson is thus established by the intrinsic activity of an invagination localized on a limited portion of the median wall of the nasal sac. In later works, Peter (1902) was concerned with the ectodermic thickening of the anterior neuropore and concluded that it has no relation with the paired lateral olfactory outlines.

Beecker (1903) studied the development of the nasal region in several reptiles: Platydactylus guttatus, Tropidonotus natrix and Lacerta agilis. He observed that the nasal canal was divided into the vestibule and the zone of the turbinals. The nasal sac and choanal canal are largely developed transversely and compressed dorso-ventrally. The choanal canal has a horizontal and a descending branch. The horizontal branch forms an internal lateral pocket; the descending branch has a small angular pocket directed obliquely upwards.

The organ of Jacobson opens into the oral extremity of the choanal groove. The true turbinal of reptiles originates from the lateral wall of the principal portion.

Description of the Stages. Tropidonotus Natrix, 4 *cm. in total length,* the embryo being unrolled (Fig. 35). This is the only stage which we have been able to examine; we have studied it in transverse sections.

A depression of the lateral wall of the head gives access to the olfactory cavity; this is entirely filled in its anterior portion with a cellular mass, composed of polyhedral or round cells with a large nucleus; this is the vestibular region. Passing to the posterior portion, a lumen is encountered which

Fig. 35—X 60. Adder, 4 cm. in total length (transverse section of the nasal cavity and the organ of Jacobson; right side). 1. Nasal cavity; 2. Sensory epithelium; 3. Organ of Jacobson; 4. Choana.

pushes the cells towards the periphery, in the form of an epithelial wall. The dimensions of the cavity are increased as we pass from before backwards; an enlarged dorsal region and an elongated ventral portion may be recognized under the form of a fissure. The epithelium differs in these two zones. In the superior portion it is provided with a superficial layer of cylindrical cells, while in the inferior part it is much thinner

and is formed of round cells (Fig. 35). The two nasal cavities approach one another, and the intercalated mesenchyme forms a septum, larger below on account of the obliquity which each cavity attains from above downward and from within outward.

At a distance of 280 mikra from the anterior extremity of the cavity, and 428 below the nasal roof, the internal wall sends out a diverticulum which sinks into the septum, constituting the organ of Jacobson (Fig. 35). It communicates with the nasal cavity by an antero-posterior extent of 60 mikra. It is prolonged longitudinally in front of and behind its union with the olfactory organ, 120 mikra anteriorly and 130 posteriorly; its total length is 310 mikra. Its anterior and posterior extremities are solid cellular masses. The entire anterior segment is greater in width than in height; its dorsal wall is very thick (114 mikra), while the ventral wall is only 21. The lumen has the form of a crescent, with concavity inferior, on account of the convex ridge made by the ventral wall on the interior of the cavity. The dorsal wall presents a superficial layer of greatly elongated cells having the characteristics of sensory cells. The ventral wall is provided only with cubical or round cells. The posterior segment of the organ of Jacobson is a cylindrical canal with walls of uniform thickness and covered throughout with sensory epithelium.

At the level at which the ventral region of the cavity forms the evagination of Jacobson, its vertical extent increases and it attains the buccal wall so as to form the choana.

The external wall of the nasal cavity is strongly convex and corresponds to a concavity of the internal wall. In the portion situated behind the choana, the convexity of the external wall is of less extent vertically; it is localized in the middle portion of the wall and forms a very slight ridge, representing the outline of the turbinal.

The posterior extremity of the cavity forms a cul-de-sac, and the wall is prolonged posteriorly in the form of a solid epithelial mass.

The sections including the posterior extremity of the organ of Jacobson and of the nasal cavity pass through the olfactory bulbs and show the branches of the olfactory nerve divided into two groups, one for each of these organs. The disposition of the olfactory apparatus in the viper is the same as that in the adder.

ANGUIS FRAGILIS, 25 *mm. long* (Figs. 36 and 37). The general form of the cavity is similar to that of the adder. It is long vertically, in transverse sections, and oblique inferiorly and externally. The superior portion, which is spacious, is covered with very thick epithelium; the ventral portion, which is narrow, is covered with an indifferent, thinner epithelium.

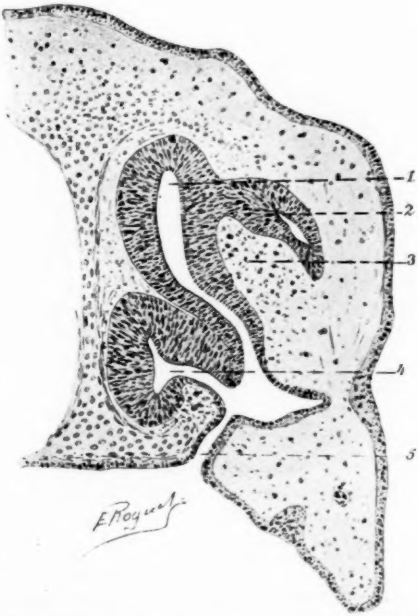


Fig. 36—X 68.5. Blind-worm, 25 mm. total length (transverse section passing through the nasal cavity and the organ of Jacobson, showing an epithelial bud of the external wall sinking into the mesenchyme; left side). 1. Nasal cavity; 2. Epithelial bud; 3. Mesoderm of the turbinal; 4. Organ of Jacobson; 5. Choana.

A central cartilaginous lamina begins to be differentiated in the septum. Between this septum and the inferior extremity of the nasal cavity, is the organ of Jacobson, a solid epithelial mass anteriorly and posteriorly (Fig. 37) and a cylindrical

canal in the remaining portion (Fig. 36). The communication with the nasal cavity is placed, as in the adder, on the internal wall of the choana. The cylindrical cells begin to differentiate at the level of the dorsal wall of the organ of Jacobson, which is composed of very thick epthelium. The thin ventral wall is raised slightly towards the cavity (Fig. 36).

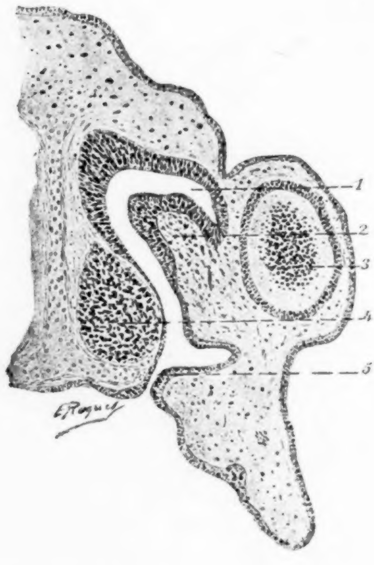


Fig. 37—X 60. Blind-worm, 25 mm. long (transverse section passing behind that presented in Fig. 36; the turbinal is limited above by a fissure which has replaced the epithelial bud of the preceding section. The organ of Jacobson is represented only by a cellular mass; left side). 1. Superior fissure; 2. Turbinal; 3. Eye; 4. Organ of Jacobson; 5. Choana.

A turbinal, already well developed, is found on the external wall of the olfactory cavity. It is possible here to see distinctly how a turbinal is formed (Figs. 36 and 37). The external wall presents a convexity limited above by the nasal lumen, which penetrates into it in the form of a fissure. This

increases and is directed outward and then downwards, thus causing a ridge on the external wall—a mass of mesenchyme covered by an epithelial layer projecting into the cavity. The base of this mass has a height of 250 mikra and a transverse extent of 285.

The fissuration is effected in an epithelial mass, resulting in a budding of the external wall (Fig. 36). The cells which form these buds are round, packed closely together, having a distinct border, a finely granular protoplasm staining well with carmine, and a deep nucleus, often seen dividing. The beds are not separated from the mesenchyme by a limiting membrane; their borders are indicated only by peripheral elements arranged in a regular layer. The nasal lumen penetrates into the mass, destroys the cells and arranges them in two epithelial layers, which border then on one fissure (Fig. 37).

The nasal cavity terminates in a cul-de-sac, behind the posterior extremity of the organ of Jacobson. Nerve fibres are seen passing from the olfactory bulb into the two organs, those of the organ of Jacobson being the most anterior.

Three centimeters. The nasal cavity and the organ of Jacobson increase in length, and their lumen is of greater extent. The turbinal is much more evident, a round ridge with thick pedicle. The nasal epithelium is very thick on the superior border of the turbinal and upon the walls throughout their extent, subjacent to the latter.

All portions with thick epithelium have a superficial layer of cylindrical cells. The inferior border of the septum is enlarged transversely; the inferior portion of the internal wall of the choanal fissure takes part in the buccal roof, thus the organ of Jacobson, completely separated from the nasal cavity is seen opening directly into the mouth.

Four centimeters (Figs. 38 and 39). The nasal cavity is large and of elliptical form on transverse sections. It has a floor slightly concave in place of being elongated to a point towards the buccal roof as in the preceding stages. The turbinal is greatly developed, beginning 340 mikra from the anterior extremity of the cavity and having a length of 360 mikra. Its anterior extremity is a slightly elevated ridge with a large base, but its height increases little by little and its pedicle is contracted. The thickness of the pedicle towards the middle portion is 107 mikra; the height of the turbinal (distance from the base of the pedicle to the free border) measures 378 mikra

(Fig. 38). It becomes thin and low gradually towards the posterior extremity.

The fissure which circumscribes it ventrally sinks into the axial mesenchyme at first from below upward and then from without inward. The surface of the turbinal is thus defined,

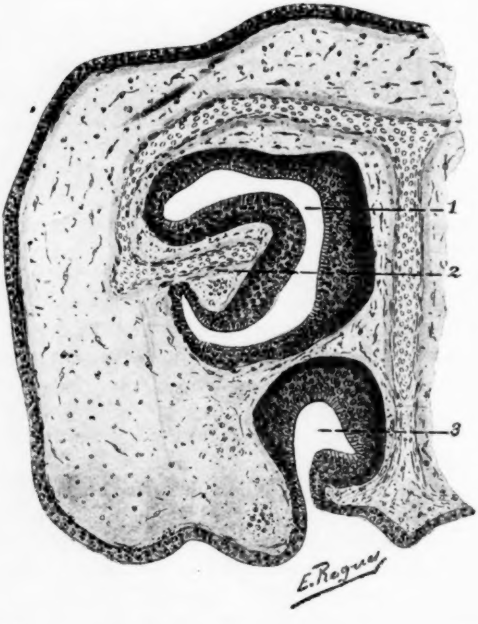


Fig. 38—X 68.5. Blind-worm, 4 cm. long (transverse section passing through the nasal cavity in which a pedunculated turbinal projects and through the organ of Jacobson opened directly into buccal cavity; right side). 1. Nasal cavity; 2. Turbinal; 3. Organ of Jacobson.

the free border is displaced and the organ has the appearance of being rolled on its axis.

The nasal cavity is surrounded by a cartilaginous capsule, still in fair way of development, at the level of the inferior wall. The external wall sends out a lamina which penetrates

into the turbinal and lies in the middle of the mesenchyme which it follows up to the level of the free border, being subjected to beginning rolling.

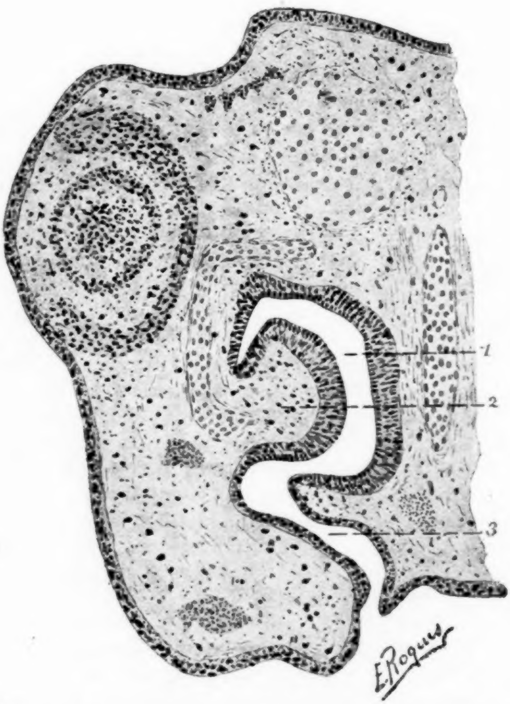


Fig. 39—X 68.5. Blind-worm, 4 cm. long (transverse section, posterior to that represented in Fig. 38, showing the choana which has acquired a definite arrangement; right side). 1. Nasal cavity; 2. Turbinal; 3. Choana.

The organ or Jacobson has a length of 370 mikra and the lumen occupies it almost entirely. It communicates with the buccal cavity, 220 mikra from its anterior extremity by a small fissure which arises from the internal border of its floor (Fig.

38). It presents throughout its extent a thick dorsal wall covered with sensory epithelium and a thin ventral wall, projecting into the cavity, formed of cubical or polyhedral cells.

The posterior extremity of the organ of Jacobson appears at the level of the choana. This last is a narrow canal directed obliquely from above downward, and from without inwards, arising at the infero-external angle of the nasal cavity (Fig. 39). The choanal canal and the nasal region subjacent to the turbinal are covered with flat epithelium; all the other regions, including the turbinal, are provided with thick epithelium, the superficial layer of which has cylindrical elements. The organ of Jacobson is in relation with a cartilaginous groove, opened externally, which covers its internal and inferior walls; this is independent of the nasal septum.

Seven centimeters. (Embryo has two small posterior members.) The nasal cavity is large at its anterior extremity; it opens externally through the middle of the external wall. The region of the opening is covered with pavement epithelium on the inferior wall and the parts adjoining the external and internal walls, while the other portions are covered with cylindrical epithelium. The relations of the nasal cavity and of the organ of Jacobson are as in the adult. The bony skeleton is already well developed; external to the cartilaginous capsule are seen the vomer, maxillary and nasal and, towards the middle portion of the external wall, the external nasal gland. The turbinal is clearly pedunculated and it describes a half turn of enrolling.

Lacerta Muralis. The olfactory fossette in a 6 mm. embryo is deep and opened below. The primitive palate is not formed at this stage. The organ of Jacobson opens on the internal wall of the fossette near its inferior extremity. It has for a certain distance the form of a groove, then forms a cylindrical tube isolated from the nasal wall.

At the stage of 7.5 mm., the ridge of the external wall is developed, being formed, as in the blind-worm, by fissuration of a solid epithelial mass; the internal and external nasal cushions are fused for a certain extent. The opened portion, situated behind the primitive palate, receives the end of the canal of Jacobson. The 10 mm. embryo already presents the characteristics of the adult. The cartilaginous skeleton is well differentiated; the ridge which becomes the turbinal now occupies the superior surface, and forms an enormous prominence

in the olfactory cavity, which is reduced to the two fissures limiting this ridge. The organ of Jacobson is prolonged in front of the anterior extremity of the olfactory cavity and opens directly into the buccal cavity.

BEGINNING OF THE OLFACTORY OUTLINE. Born, in an embryo of Lacerta agilis with ten primordial segments, observed a zone of ectoderm between the anterior neuropore and the primitive ocular cavity, in which the cells take on a cylindrical form; this is the olfactory plate.

Peter studied the evolution of this olfactory plate in the lizard, and accorded to the multiplication of the cells constituting it the most active role in the growth of the organ. He found the olfactory fields well marked in the stage of eleven primordial segments. He found on the ventral wall of the anterior neuropore, in the stage of sixteen primordial segments, an ectodermic thickening analagous to that described by Kupffer, but it had none of the characteristics of the sensory plakode and never was in relation with the paired olfactory outlines.

EVOLUTION OF THE OLFACTORY ORGAN. The olfactory fossette resulting from the invagination of the corresponding ectodermic thickening, grows particularly by the mitotic activity of the cells constituting this outline, as was well noted by Peter (1902). The neighboring, indifferent epithelium forms only the bordering portions. Rathke (1838) and Born (1879) described at length the ultimate changes of these portions.

The thick postero-superior border is prolonged, in the form of a curtain, anteriorly and inferiorly into the area of the nasal depression. The free border of this fragment (nasal roof of Rathke) is entirely straight at first, then advances further at its middle portion and is prolonged as a rounded ridge.

At a period at which the nasal sac is still largely open (Lacerta agilis with 47 primordial segments), Born observed the appearance of a groove indicating the organ of Jacobson, from an active depression of the ventral extremity of the median wall of the nasal sac.

The space between the two nasal fossae forms the frontal bud of Rathke and each of its parts forms the internal nasal bud of Koelliker. The external border of the fossette is formed by the external nasal bud, which a groove (lachrymo-nasal) separates from the superior maxillary bud. Fusion of the

nasal buds caused at first by the crowding together of the epithelium, then by the union of the two subjacent masses of mesenchyme, separates the nasal groove into two orifices. This fusion is effected in the adder with a head length of 4 mm. The external orifice, in the form of a fissure, is placed upon the plane of the face and the posterior orifice of the choana is situated on the palatal plane.

The bridge of fusion which forms the primitive palate grows, the palatal prolongations of the superior maxillary are united with the nasal septum, and the choanae are displaced backward. We have observed that the inferior part of the septum which divides the choanae from one another grows transversely in such a manner as to separate them. As a consequence of this growth, which causes a transverse enlargement, the orifice of the canal of Jacobson, which opens on the internal wall of the choana, is carried along the palatal surface, and the definite opening of the choana is finally external to the communication between the canal of Jacobson and the buccal cavity. The two organs are then independent of one another; this process is effected in the blind-worm at the stage of 4 cm. of total length.

The organ of Jacobson does not remain here in the state of a groove communicating throughout its length with the nasal cavity as in the Anura; it is transformed into an isolated, well-defined canal, entirely independent of the olfactory cavity.

Two interesting points are found in the nasal cavity: the formation by growth antero-posteriorly of a vestibular region, and the delimitation of a ridge on the external wall in the form of a turbinal. While the turbinal is a simple ridge in the adder, in the blind-worm it is comparable to those of the mammals.

We have seen how it is established by the growth of the fissure of the nasal lumen. Some epithelial buds begin to isolate a region of the mesenchyme, then the fissure penetrates into the bud and the mesenchymatous mass, covered by the epithelium of the cavity and of that which is organized along the fissure, forms a free ridge in the nasal cavity, simply united to the external wall by a base, more or less large, forming the pedicle of the turbinal.

The round, embryonic cells, which constitute the walls of the nasal cavity, are differentiated into cylindrical cells at the

level of the nasal roof at the beginning of development; their territory is already large in the blind-worm of 2.5 cm.

The differentiation takes place on the internal wall and the turbinal; the region, subjacent to the turbinal remains covered with indifferent epithelium. The sensory cells in the organ of Jacobson, limited to the dorsal wall, are completely differentiated at the stage of 2.5 cm.

The lateral nasal gland, of which Born found the beginning in the form of an epithelial bud on the external wall, exists in our sections of the blind-worm of 7 cm. It is formed by a group of culs-de-sac, situated external to the capsule, near the middle part of the external wall.

In the Crocodilia, according to Voeltzkow, the development is analogous to that of the saurophidians. According to Meek (1863), in the 5 mm. stage of Crocodilus porosus, the nasal sac is completely formed and the anterior and posterior nasal orifices approach very closely to one another. A depression of the frontal wall represents the origin of the organ of Jacobson. At the stage of 7 mm. an evagination corresponding to the lachrymal canal is the beginning of a simple accessory cavity of the nose. The invagination representing the canal of Jacobson is absent in specimens of 7.75 mm. in length. Sluiter (1892) and Röse (1893) found an outline of the organ of Jacobson always present in their investigations. Seydel and Voeltzkow gives but slight indication of it in the chelonians. The organ of Jacobson, according to Seydel, is represented by a groove on the median wall, while Mihalkovics sees this organ in a canal which opens on the septum and has glands in its blind extremity.

ABSTRACTS FROM CURRENT OTOLOGIC, PHINOLOGIC AND LARYNGOLOGIC LITERATURE.

I.—EAR.

A Case of Purulent Sinus Thrombosis with Opening of the Middle-Ear and Preservation of the Ossicles.

G. Braat (*Tydschr. v. Geneesk.*, Feb. 3, 1906) treated a 25-year-old car conductor, who had suffered from youth from a purulent bad-smelling secretion of the right ear, slighter during the last ten years. In August, 1902, he was taken with earache lasting a few days, with vomiting for which he took to his bed. When he attempted to get up he was taken with chills and dizziness, and fell. Pain and swelling of the right sternoclavicular joint appeared, and a bad-smelling secretion appeared in the right ear, of moderate quantity. He suffered constantly with numbness. Braat was consulted three weeks after the fall. He found, on September 7th, pain and swelling of the sternoclavicular articulation. In the right ear there was bad-smelling, bloody muco-pus. The drum had a perforation posteriorly with thickened margins; beyond, it was sound; the malleus was visible. There was no swelling in the canal or behind the ear. There was some sensitiveness on pressure over the mastoid fossa, anterior and posterior part of the process and on a spot 2 cm. behind the process. There was painful swelling of lymph nodes behind the jaw and under the sterno-cleido-mastoid muscle. Temperature and pulse normal for two days. Up to the time of the operation, the sensitiveness was more and more concentrated on one spot 2 cm. behind the mastoid process, although it became less; the lymph nodes became painless and smaller. Pain appeared in the forehead; in the last few days pulse and temperature remained normal. Internal organs normal; no swelling of the spleen. Acoustical acuity right ear for speech at 5 m., whisper 0.5-1.5 m.; left ear normal. Operation of September 16: incision 1 cm. behind the auricle; periosteum very firmly attached to the bone; dura soon laid bare; bone sclerotic; mastoid cells are invisible; the antrum lies very deep and has thickened mucous membrane with granulations and little pus. A probe passes at the posterior wall into a cavity with soft walls. While laying the sinus transversus bare, yellow pus escapes from behind the antrum out of the sinus. The wound is enlarged, the entire

sinus laid bare, cut open, the abscess scraped out and tamponed with small pieces of gauze; likewise the mastoid wound and external canal. Vomiting ceased. Two days later the dressing was changed on account of amount of secretion; the gauze was retained in the sinus and antrum and was changed four days later. The sinus closed quickly. October 1st, operation continued: the bony posterior wall of the external canal was removed, while the ossicles were retained; operation completed with Stacke's plastic. First change of dressing October 7th. Patient left for home October 10th; entirely healed. December 28, 1902, with speech at 5 m. and whisper at 0.1 m. A little pus was noticed January 27, 1903, at the anterior part of the spur; the place was touched with lactic acid. On March 8th and April 12th there was again a trace of pus and a small crust has formed since from time to time at that spot.

Observation October, 1905: drum with a chalk patch before the malleus, large perforation behind it, the long arm of the incus visible; from the drum a membrane goes over the attic region and posteriorly over the former surface of the wound. Speech at 5 m.; whisper at 1 m. Tuning fork tests for C2: Weber to right; Rinné right negative; Schwabach neither lengthened nor shortened. Braat considers the preservation of the ossicles very important with regard to the auditory acuity.

Posthumus Meyes praised the result, but believes that the auditory perception took place here chiefly through the round window, which he finds closed by a very thin membrane.

Braat denied the presence of this membrane.

Schutter finds the result quite good; however, such operating should not be followed. The preservation of the ossicles does not ameliorate the hearing; their relationship becomes abnormal, their attachments partly lost, and therefore the operation is less radical and the chance of a cure smaller, although the case demonstrated had a good result.

Quix agrees with the foregoing speaker. The drum with the loose ossicles will interfere with the hearing. The communicated auditory acuity is not very good and would perhaps be better if the ossicles were removed.

Braat replied that the ossicles can be easily removed under narcosis; he did not think that the functional results would be better then.

Blaauw.

A Case of Probable Inflammation of the Basis Cranii, Beginning as an Acute Mastoiditis.

H. Braat (*Tydschr. v. Geneesk.*, Feb. 3, 1906) saw his patient eight days after she was awakened with a pulsating pain behind the left ear; two days later, the left upper eyelid became swollen, closing the eye; after a few days this swelling disappeared. Braat found the left auricle projecting from the head, distinctly different from the right side; the mastoid process was slightly swollen, red and very sensitive on pressure. The drum membrane was entirely normal, no swelling or redness of the posterior wall of the canal. Hearing normal; also the tuning fork tests. Temperature 37.8°-38.1° C. Rest in bed and ice on the mastoid process were ordered. Two days later the condition had not improved, mastoid pain increased with much headache; temperature 37.9°-38.5° C. Patient was taken to the hospital; she was very moody, complained of severe pain behind the ear; the upper eyelid was again swollen, the left eye deviated to the left, but could be moved well in all directions; pupillary reflexes on both sides normal; the entire head had a slight caput obstipum position to the right; speech was slightly impaired; the left side of the tongue was very swollen; when she showed the tongue it deviated strongly to the right; she could not move it to the left; the uvula was turned somewhat to the right. Sensation for sweet, salt, sour and bitter was possible over the entire tongue; sensibility everywhere normal. She vomited a few times. The left cervical region was not markedly painful, the internal jugular was not palpable; the entire region was hyperesthetic and hypalgesic. Urine frequently examined, normal; also fundi oculi always normal; laryngoscopic image normal.

It was difficult to make a diagnosis; the complaints were chiefly localized in the mastoid region with pains radiating in the parietal region. The intact middle ear, the increasing and diminishing swelling of the left eyelid and, at the end, the swelling of the left half of the tongue which receded again for the most part after a few days, while the deviation to the right remained, made it probable that we had to deal with a process in the mastoid not originating in the middle ear cavity, to which a periphlebitis or phlebitis was added; on account of the rise of temperature a perisinuous abscess was expected.

Nineteen days after removal to the hospital, Braat operated; after incising the skin the subcutaneous tissue was found in-

filtrated and a few swollen glands were found; the bone was not injected, the mastoid cells were entirely normal; he did not continue his operation to the antrum; posteriorly no infiltrated bony tissue nor pus was found, so the operation was completed. Ten days later the wound was closed, the pain was decidedly less and the nausea had disappeared. She left the hospital, but her condition was not improved. The swelling of the left side of the tongue and of the left upper eyelid returned at intervals. The headache returned with increased intensity and she complained more frequently of pains in the occiput. This condition continued till about for weeks ago when the pain in the ear became worse and a little later a little pus was discharged. Speaker being absent the patient was taken care of by Dr. Ter Kuile. Shortly after, Braat found a small perforation in the posterior lower quadrant with little or no secretion; after enlargement of the perforation no pus discharged, nor after Politzerization.

At present the tongue is directed still to the right, although she can bring it more to the left corner of the mouth; there is no more swelling of the upper eyelid and the position of the left eye is normal; temperature about 38° C. The pulse is mainly small and frequent, 110-140 and never slow. In consultation with Prof. Pel, Braat considers it most probable that there is an inflammatory process at the base of the brain in which the hypoglossus nerve and the right external ramus of the left vago accessorius are involved; he can not decide if there is an extradural abscess or a tuberculous process; in the latter case it should be assumed that there are a few tubercles at the base of the brain which press or irritate the nerves. Braat did not consider the indication present for puncture of the sinus, as the bone near the sinus was normal. Zaalberg considers this argument insufficient and would perform puncture.

Delsaux asked if the general sensibility had been examined, and mentions the case of a lady who was operated for pains in the mastoid which disappeared although the mastoid was normal; later patient became very sick, weak and an unilateral anesthesia was found. Braat's patient was examined by a nerve specialist, who found no anomalies.

Blaauw.

The Surgical Treatment of Meningitis of Otitic Origin.

ALEXANDER (*Archiv. Internationales de Laryngologie,* 1905, p. 711). The last few years have witnessed great progress in the surgery of suppurative affections of the labyrinth. A like advance has not occurred in the results of treatment of otitic meningitis. This, in part, can be explained by the fact that in most complications of otitis suppurativa, meningitis has caused the death.

Nevertheless, today most otologists believe in the privilege of intervention, and cases of purulent meningitis, even well advanced, have under favorable conditions been cured by surgical interference. Such intervention consists in

1. Immediate operation upon the ear and the removal, as thoroughly as possible, of the diseased focus.
2. Exposure of the dura mater.
3. Incision and drainage of the intradural cavity.
4. Tamponing and aspiration of the fluid through the incision in the dura.
5. Lumbar puncture.

Meningitis may be divided anatomically into

1. Purulent meningitis.
2. Tubercular meningitis.
3. Serous meningitis.

Of these, from a therapeutic standpoint, we can hope for nothing in tubercular meningitis. Until recently the same was true of purulent meningitis; now we have three cases reported cured by operation (one by MacEwen and two by Gradenigo). The proof of their purulent nature was furnished by the lumbar puncture. Hinsberg reports ten cases and four cases were seen in Politzer's clinic, where pus was evacuated at the operation.

Internal pachymeningitis is also amenable to operation if taken sufficiently early.

Serous meningitis is, however, where our greatest hope of success lies. A considerable number of cures have been reported. Exact proof of the conditions present in such cases the author admits is lacking. Cases which did not get well, however, showed purulent deposits at the autopsy, while those which recovered showed a congestion and tension of the dura and a normal fluid. Much depends upon the virulence of the particular micro-organism. If this could be determined by in-

oculation or otherwise we could form a fair idea as to the prognosis. Up to the present time this has not been attempted. Of prime importance is the discovery of the exact focus in the ear from which the infection proceeded. This is often difficult or impossible. It is advised, accordingly, after thorough attention to the ear, to expose the dura of both middle and posterior fossae, if clinical symptoms for localization was wanting. In case the dura is altered, a free incision is demanded and a gauze wick introduced. On the other hand, if no alterations in the dura nor increase in intradural tension can be recognized, it is safe to delay entering the cranial cavity even in the presence of meningeal symptoms.

Alexander's views regarding the value of lumbar puncture and the practice at the Politzer clinic are especially interesting. It would appear that he regards the results of such examination as doubtful and possibly confusing from an operative and even diagnostic standpoint, for it is the rule in the Politzer clinic to consider every case of meningitis operable if the physical condition permits. In other words, pus and microbes in the spinal fluid are not a contraindication to operation. We may be dealing with a case of meningitis which is curable, or it may be a brain abscess which causes the pus in the fluid. This is equally true when the fluid is clear. Here we may have the early stage of a meningitis. As a therapeutic measure it does not offer any promise. Alexander also is inclined to believe better results follow the free incision than from a mere intradural puncture and aspiration.

Incisions from ¾ to 1 centimeter are long enough and will not cause hernia unless an encephalitis and edema of the brain exist. He regards such incisions as free from danger, if practiced under strict aseptic precautions.

Post-Operative Meningitis.

ZERONI (*Archiv. für Ohrenheilkunde,* Vol. 66, page 199). Fatal cases of meningitis following operation for chronic otorrhea, without any previous complication, are becoming only too frequent. Operators have been inclined to regard such results with seeming indifference—dismissing them with the bare statement that the meningitis had been existent already but unrecognized. Such treatment of these tragic accidents tends to discredit otitic surgery with the profession and

laity. Acute cases do not fall within this class, for we can never tell in advance how extensive the lesion is. Zeroni believes that the majority of purely chronic cases operated on which are followed by meningitis will show previous suppurative movement of the labyrinth. In his opinion, and that of several other observers, the latent labyrinthitis is made active by the chiseling, and he regards this as a serious objection to the extensive use of this instrument. Macewen has seen meningitis follow the removal of granulation from the middle ear. In confirmation of his views the author gives the histories of 29 cases where the autopsies revealed, without exception, labyrinthine suppuration. The appearance of the meningitis was frequently directly after the operation. In one case it was during the operation that chills and high fever were observed. In 15 of the 29 cases no symptoms of any kind were present.

The results of the pathologic examination show that the labyrinthine disease was not of recent date. It is probable, however, that a decided increase in its intensity followed the operation of the various lesions of the labyrinth. A study of the 29 cases shows an especial danger for post-operative meningitis where there are defects in the labyrinthine windows. Indeed, the existence of a communication between the labyrinth and the operative field in the middle ear is the indirect cause of the meningitis. While chiseling is a potent factor in exciting it, it is not the only one, as is shown by several cases where the chisel was not used.

In a certain number of instances, however, the autopsies revealed no involvement of the labyrinth. The histories of 11 such cases are given. In all but two it was possible to demonstrate the presence of pus centres between the dura and the bone. This, Zeroni believes is the rule where no inner ear disease is present to explain the meningitis. It is true the intact dura offers resistance to the penetration of bacteria, but they can easily enter along the normal passages in the dura, such as that for internal carotid or for the acoustic nerve.

In many of such cases an intermittent meningitis is present, not permitting of a diagnosis. The operation serves to set this into activity, in all probability by allowing fresh bacteria to get in. Further, the effect of the resulting blood clot and tampon is to shut off the drainage to surface which had previously existed.

In general, the common danger in all cases rests in the fact

that deep, unapproachable foci of pus are not discovered and so not drained. This is true even in the labyrinth cases where fistulae exist, for the drainage is entirely insufficient. In the author's opinion the avoidance of this most unpleasant complication is to be found in refraining from all operation where labyrinthine disease is suspected.

Unfortunately the diagnosis of such disease is often impossible. Deafness of a pronounced degree is not always present and vertigo is frequently met in chronic middle ear suppuration. In the case of deep-seated areas of pus the outlook is better, for here, instead of avoiding all interference, we can hope to find them and remove the disease. Caution is, however, to be continually observed in all manipulations over or on the inner wall of the middle ear. *Harris.*

Otologic Report from Prof. Gerber Policlinic and Private Practice, for Year 1904.

M. MAGNUS (*Arch. f. Ohrenh.*, Vol. 67, H. 1, p. 55).

Total number of patients 4,530.

Diseases of ears	2,027
Diseases of nose and naso-pharynx	2,515
Diseases of mouth and pharynx	1,881
Diseases of larynx and throat	444
Total	6,867
Operations on ear	301
Operations on nose	741
Operations on sinuses	56
Operations on mouth and pharynx	352
Operations on larynx and throat	45
Total	1,495
Diseases of auricle	80
Diseases of external meatus	421
Diseases of drum	99
Diseases of middle ear	1,252
Diseases of mastoid	115
Diseases of internal ear	25
Diseases of brain, etc	35
Total	2,027

Removal of foreign bodies	9
Incision of furuncle, etc.	39
Paracentesis	121
Wild's incision	1
Operation for deformity	1
Foreign body operations	3
Retroauricular plastic	2
Sinking abscess	1
Schwartze's mastoid	41
Radical (Stacke's)	30
Secondary mastoid (acute)	10
Secondary mastoid (chronic)	8
Bulb laid bare	4
Sinus opened	10
Jugular ligated	7
Labyrinth opened	2
Lumbar puncture	6
Dura incised	4
Puncture cerebellum	2
Total	301

Several cases and all mastoid operations are given in detail.

Some Relations in the Blood-Supply of the Inner Ear which have a Practical Bearing on the Clinical Study of Otology.

Shambaugh, Chicago (*Archives of Otology*, Vol. XXXV, No. 1). The arterial supply is brought to the inner ear through a single vessel, a branch of the basilar artery, which enters the labyrinth along with the auditory nerve through the internal auditory meatus. In a detailed study of the pig, the sheep, and the calf, the author found that a single vessel, the vein of the aquaeductus cochleae, drained the blood from the entire labyrinth. The first two branches of the labyrinthine artery, following the courses of the branches of auditory nerve, supply the entire vestibule and semi-circular canals, with the exception of the saccule. These branches of the labyrinthine artery are terminal vessels, and carry the sole blood-supply to definite areas in the labyrinth. After giving off the vestibular branches, the labyrinthine artery breaks up into a number of branches before it enters the cochlea. These several branches are connected by anastomotic loops before any of the terminal branches are given off to the several parts of the cochlea.

The occurrence of a typical case of Meniere's disease, where there is a profound disturbance in the vestibule and semicircular canals, as evidenced by the occurrence of vertigo and nausea, as well as a profound disturbance of the cochlea, as shown by severe tinnitus and deafness, can be brought about only by some disturbance in the circulation in the entire labyrinth.

Where there is disturbance in the circulation of one or several of the terminal arteries of the labyrinth, there result symptoms which are not the Meniere symptom-complex. For example, the lodging of an embolus in the anterior vestibular artery would result in disturbance limited to the utricle and the horizontal and the superior semi-circular canals. This would cause disturbance of equilibrium without molesting the function of hearing. On the other hand, a disturbance in the circulation, limited to the cochlea without involving the vestibule or semi-circular canals, would produce tinnitus and deafness but not disturbance in equilibrium. Again, an embolus lodging in the terminal artery, which supplies the apical coil of the cochlea, would perhaps cause deafness for the lowest tones without disturbing the upper part of the scale.

Campbell.

Four Temporal Bones of Two Deaf Mutes.

R. Panse (*Archiv. f. Ohrenheilk.* Bd. 64, 2 and 3, S. 118). Two of these have been described before, but have been re-examined in the light of more recent investigestions. His findings were:

First case, left side—Bony ankylosis stapes with oval niche; rarefaction of stapes-vestibular cartilage. Reissner's membrane over the pars basilaris of the cochlea atrophic. Clefts in the lig. spirale. Cortis membrane displaced into the fairly normal sulcus spiralis, and held by a layer of cells. Pars basillaris everywhere degenerated. A few cells in the ganglion spirale; acusticus degenerated. Endarteritis obliterans in art. cochlearis in the acoustic nerve.

R. E. Exudate between neck of hammer and drum, bony ankylosis of posterior stapedial bar. Blood vessels in oval window widened, as on promotory. Anterior and external ampullae distorted. Epithelium colloid degenerated. Nerves atrophied. Thickening of wall of an artery. Endarteritis of

vestibular artery. Colloid degeneration of macula utriculi. Dilatation of sacculus and degeneration of the epithelium. Scalae of cochlea widened. Reissner's membrane lengthened. Stria vascularis normal. Lig. spirale rich in blood vessels. Membrana corti malplaced. Organs of Corti seen only as flat mounds of atypical cells. Very few ganglia in canalis spiralis. All other parts normal.

Second case, right ear. Cochlea shows few vessels. Membrane of Reissner ravelled out in vestibular and basal portion, wanting in middle and superior portion. Corti's membrane wanting in frayed portion, otherwise present as mounds or brushes covered with epithelium. In the middle, Corti's organ retained as clumps of colloid and atypical cells. Stria vascularis is similar and very poor in vessel. A few spiral ganglion cells and degenerated nerve fibres.

L. E. Part of Reissner's membrane absent; membrana corti almost entirely present but abnormal in appearance. Organs of Corti an indistinct mass of cells. Stria vascularis colloid degenerated. A few spiral ganglia and acoustic fibres.

Serous Meningitis.

Arnold Knapp (*Archives of Otology,* Vol. XXXV, No. 1). A man aged 18, after an acute otitis media, had tenderness and swelling over the left mastoid process. These symptoms persisted for one week, then abated; but pain over the left side of the head and vomiting persisted.

The pulse rate was slow, he was languid and somewhat stuporous. His sight began to fail. There was marked optic neuritis, R. V.=15/50, L. V.=15/20. Visual fields normal.

On operation the mastoid, antrum and typanum were found to contain swollen but healthy mucous membrane. The ossicles were healthy and the tegmen of tympanum and of antrum showed no defect. Nevertheless, the tegmen tympani was removed from the orifice of the tube back to the superior margin of the petrous pyramid. The dura was healthy and pulsated. The posterior segment of the mastoid process was then removed and the sinus and the dura of the posterior cerebral fossa exposed. At the upper posterior margin of the mastoid process the bone was found discolored and soft. The dura directly above the knee of the sinus was thickened, discolored, bled freely and was covered with apparently old granulations.

A similar area of discolored dura was found over the sinus. The dura above the sinus was incised and perfectly healthy brain exposed. The brain was punctured without result. The sinus was opened and free hemorrhage took place. The bone was then removed back of the sinus to expose the carebellum. The dura there was found perfectly normal; it was incised and this was followed by a gush of cerebro-spinal fluid. This incision was enlarged and kept open to facilitate drainage of the liquor.

The subsequent course showed immediate and continuous improvement. Where the dura was discolored, it had given way as if it were gangrenous and the large defect was filled with infiltrated brain tissue. This was removed with a curette. A small circumscribed cerebral hernia which formed was later covered by a plastic operation. *Campbell.*

Sound Pressure in the Organ of Corti.

ZWAARDEMAKER (*Tydsch. v. Geneesk.*, Feb. 3, 1906) shows a model for the purpose of demonstrating that the sound vibrations in the organ of Corti, after being analyzed by the resonating fibres of the basillar membrane, exercise a sound pressure toward the modiolus. The anatomic demonstration of his interpretation is found in the zona arcuata being unstriped and Corti's fibres failing to have a true joint. The outer hair cells are pressed by the conglomeration of cells of Hensen.

The same mechanism is found in birds. The small bars of the haircells are not needed for this representation, although they can be connected in it (for particulars, *Arch. f. Physiol.*, 1905, Suppl. p. 124).

Struycken asked how he could consider the vibration of the membrane of Corti; it is not clear how a membrane with an elasticity smaller than that of water, could vibrate in water.

Zwaardemaker replied that the theory of Helmholtz-Hensen is assailed by this observation. Helmholtz gives the calculation that it is possible in the Beilagen of his Tonempfindung.

Struycken tried experimentally different membranes to produce vibration through resonance, but did not succeed in observing vibration in the fibers. Helmholtz took small notice in his computation of the external resistance, and just this is of high value in fluids.

Quix considered Zwaardemaker's theory a great advance

over the existing one, that the impression may be constant. The entire energy, which is supplied periodically, is transposed into a constant pressure. He observes that a string in water may vibrate very well, wherewith vortices originate.

Struycken stated that a string can do this only when it is rubbed against or has been made to vibrate in some other way; he did not agree that a membrane in water can resonate, unless energy is supplied in a more direct way *Blaauw.*

The Differential Diagnosis Between Cerebellar Abscess and Labyrinthine Suppuration.

NEUMAN (*Archiv. für Ohrenheilkunde*, Vol. 67, page 191). The symptoms of both affections are admitted by all authorities to be very similar.

Neuritis optica is often present in cerebellar abscess but is not rarely lacking. It is absent usually in labyrinthine disease but occasionally occurs.

Fever may be lacking in both.

Vertigo can be found with or can be lacking in both.

From the study of a large series of cases, Neuman regards nystagmus as the one symptom of value. This never is found in cerebral abscess. Characteristic of it, as associated with cerebellar abscess, is that it increases in intensity as the disease advances. This is never the case in labyrinthine disease. Further, "while in the latter affection the nystagmus is toward the diseased side—later entirely disappearing but persisting toward the sound side—in abscess of the cerebellum the nystagmus is at first toward the healthy ear, but suddenly changes in the other direction. If this symptom is observed cerebellar abscess can be diagnosed with certainty." The author makes the surprising statement that in the majority of cases the two affections occur together.

The report of a number of illustrative cases is given. In each case, approach to the inner ear was affected from behind and the dura with saccus endolymphaticus opened. This allows easy access to the cerebellum and the route of infection from the labyrinth. *Harris.*

Topographic, Anatomic and Clinic Investigations of the Lymph Apparatus of the External and Middle Ear.

A. MOST (*Arch. f. Ohrenh.*, Bd. 64, H. 2 and 3, p. 189; also Bd. 64, H. 4). The lymph apparatus of the ear can be divided into that connected with the brain, and lymph vessels in the

ordinary sense. The author concerns himself chiefly with the uninvestigated lymphatics of the meatus and tube.

He finds that the auricle possesses a thick network of lymph vessels which become more delicate towards the meatus. The drum has a network a piece for the dermal and membranal layers which anastamose by means of perforating vessels. The vessels of the dermal layer anastamose with those of the meatus, and those of the membranal layer with those of the middle ear. The latter anastomose with those of the tuba, at whose mouth there is another dense network of vessels. There are four groups of nodes belonging to the external ear: (1) The preauricular, (2) the infraauricular, (3) the retroauricular and (4) the deep cervical. The regional nodes belonging to the tube are the glandulae retropharyngeales laterales and the deep cervical nodes. It was impossible experimentally, to discover the nodes belonging to the mucous membrane of the middle ear.

Clinically it has been found that the lymph in otitis media takes two paths: First, that of the external ear, through the drum to the subauricular nodes, or by extension of the inflammation through the mastoid into the subcutaneous lymphatics or the lateral deep cervical nodes. Second, towards the tube and the glandulae retropharyngeales laterales and then to the gl. cervicales profundae laterales. The former occurs chiefly in adults, the latter in children.

Report of the Halle a. S. Royal University Ear Clinic for Year Apr. 1, 1904, to Mar. 31, 1905.

R. Grunert and E. Dallman (*Archiv. für Ohrenheilkunde,* B. 65, H. 1 and 2, S. 55.):

Total number new patients, 2,937.

Total number diseases external ear	744
Total number diseases drum	10
Total number diseases middle ear	2,366
Total number diseases internal ear	571
Total number form of diseases	3,691
Mastoid cases cured	96
No result	1
Under treatment	37
Removed	9
Died	20
	163

Number of ablatio conchae	1
Number of incision meatus	26
Number of paracenteses	180
Number of extrac. polyp	26
Number of mastoids	163
Number of extrac. ossicles	20
Number of tonsillectomies, ca	50
Number of adenoid oper., ca	150
Total	616

Several cases of exceptional interest are reported.

Secondary Herpes Zoster with Ear Disease.

W. Posthumus Meyes (*Tydschrift v. Geneesk*, Feb. 3, 1906) was consulted by a healthy man with rheumatic tendency, who had earache on the previous evening, with shooting pain in the back of his head and elevated temperature. Next day he had a thick sensation in his mouth and complained of deafness, noise and fulness in the left ear. Examination shows otitis media catarrhalis acuta; red swollen drum, whisper at 1 m., while in the mouth at the left side of the raphe, on the hard palate, a sharp drawn broken line of small vesicles filled with clear fluid, surrounded by a red garden, is visible, exactly in the course of the nervus platinus anterior, namely a triangle open posteriorly, the point of which approaches the incisivi. Patient was given sodium salicylate. After 24 hours the condition remained the same. A day later vesicles began to disappear, the pain practically left, the drum showed only a light redness, whisper heard at 3 m. A week later all had returned to the normal.

Meyes thinks this is a case of secondary or symptomatic herpes zoster. The explanation is not easy, as every indication of inflammation in the neighborhood of the Gasserian ganglion failed. Perhaps specific toxic causes (rheumatism, influenza) other than an inflammation of middle ear may influence this ganglion without distinctly observable symptoms.

Blaauw.

The Etiology of Serous Meningo-Encephalitis of Otitic Origin.

Stenger (*Archiv. für Ohrenheilkunde*, Vol. 66, page 144). The diagnosis of endocranial complications of chronic suppurative otitis is yet in much obscurity. The lumbar puncture in

recent years has not fulfilled the earlier predictions as to its diagnostic value. The positive findings (cloudiness of the fluid) denoting bacteria can no longer be regarded as certain evidence of a diffuse purulent meningitis. Rather may the bacteria proceed from a local inflammatory area—general purulent meningitis can never get well. To prove the contrary assertion it must be conclusively shown that the results of the lumbar puncture will reveal, beyond doubt, a general purulent meningitis.

Such findings will determine the presence of an inflammatory process inside the cranium, but not its extent or severity. Accordingly, the decision as to surgical intervention is not to be based exclusively on such results. Active meningeal symptoms may exist in a simple mastoiditis without true meningitis. Stenger gives the histories of three cases where the radical operation was performed, which were followed by symptoms of meningitis and all recovered by incision in the dura. All the symptoms were due to intra-meningeal tension and to the accumulation of cerebro-spinal fluid. *Theisen.*

A Case of Trigeminus Neuralgia with Affection of the Middle Ear.

Dr. A. Sikkel's (*Tydschr. v. Geneesk,* Feb. 3, 1906) patient, 39 years old, suffered since March from pain in the right lower jaw, which constantly increased. The attacks, which appeared as true tic, went slowly from the jaw to the cheek, the pharynx, occiput and neck. A molar was removed without result. Neuralgia treatment was without avail. Patient suffered in youth from a running ear. The patient gave the impression of suffering greatly from pain. He stated that he was unable to eat without a sudden severe pain, mostly in the under jaw, radiating sometimes to the ear, but never starting in the ear. This is the picture of trigeminus neuralgia in all its branches. The right ear shows a destroyed drum; only the handle of the malleus, with a rest of the membrane before and behind, is visible. Pus appeared superiorly and posteriorly. During the first days of treatment there was copious secretion. In view of the seriousness of the process and the fruitlessness of other treatment, radical operation was performed, after which the pains disappeared, and so far have not returned. Sikkel thinks that irritation of the ganglion gasseri, originating in the middle ear process, caused the neuralgia.

Blaauw.

The Diagnosis of Syphilis of the Auditory Nerve.

A. Rosenstein's (*Archiv. für Ohrenheilkunde,* Bd. 65, H. 3 and 4, S. 194) conclusions.

1. Syphilitic disease of auditory nerve is much more frequent than heretofore believed.
2. The most frequent affection is a basal, gummatous meningitis. Less frequent are gummatous affection of the pyramid and periostitic stenosis of internal meatus.
3. Nucleus and root of nerve frequently attacked at same time as nerve itself.
4. Syphilitic paralysis of auditory nerve can be due to nuclear or root affection.
5. Hereditary lues may be due to neuritis acustica as well as primary labyrinthitis.
6. The 8th nerve is less able to withstand syphilis than the 7th.
7. Syphilis of auditory nerve is a very grave condition, and demands careful observation and treatment.
8. Prognosis is good under these conditions.

Symptoms indicative of syphilis of the auditory nerve are not, as a rule, to be distinguished from those due to other processes in the nerve.

Systematic Hearing Exercises for Deafness.

A. C. H. Moll (*Tydschr. v. Geneesk.,* May 13, 1905) had treated a case of purulent otitis media chronica in a man whose left ear had been deaf for some time. After treatment, whisper could be heard at 1 m., common speech at 8 m. As later, suppuration started anew he had recourse to a homeopathic remedy: tinct. thujae; notwithstanding this the hearing diminished and tinnitus appeared, which increased after repeated instillations. A few days later Prof. Zwaardemaker found the hearing very much reduced. Moll observed patient in the hospital, where he underwent the pilocarpin treatment, which did no good; massage and galvanization were not effective. He now began systematic hearing exercises of Urbantschitsch. The hearing is still defective, but he can now understand ordinary speech at one meter aided by a hearing tube, which he has selected himself; his conversation is better or worse according to the distinctness of the voice and his own more or less calm or nervous condition. The amelioration, where the deafness is the consequence of an affection of the sound perception apparatus, speaks in favor of an increase of the auditory sensitiveness. *Blaauw.*

Infective Sinus Thrombosis.

KERRISON, New York (*Archives of Otology*, Vol. XXXV, No. 1). This paper is a criticism of Richard's article "on the operative treatment of infective sigmoid sinus thrombosis," an abstract of which appeared in the ANNALS OF O. R. & L., Vol. XV, No. 1, page 150.

The author believes (1) that the sinus should be opened only in the presence of symptoms or physical signs pointing fairly definitely to intra-sinus involvements; and (2) that to advise opening the sinus in spite of the absence of symptoms in all cases in which the surgeon suspects the existence of a clot, without any definite statement as to the physical signs justifying such a suspicion, is an inexact and unscientific method of expression which should not find place in otological literature.

In cases of mastoiditis with symptoms characteristic of sinus thrombosis, the author lays bare the sinus, removing every vestige of diseased bone, leaves undisturbed the overlying granulations and awaits developments. He claims the great majority of cases recover without further operative intervention. *Campbell.*

The Auscultation of the Middle Ear.

W. UFFENORDE (*Arch. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 1) concludes:

1. No diagnosis can be made by means of the distinctions of the sound, as to whether it is due to tubal or middle ear condition, as it may meet an obstruction which may absorb or reflect sound waves.

2. The blowing noise comes from the end of the catheter and the tube, the middle ear acting as a resonator.

3. No conclusion as to the consistency of the secretion can be drawn from the musical character of the sound.

4. Rales from the middle ear have a deeper note, and a secondary sound due to the secretion falling backwards. The tubal rales are higher and fewer.

5. If no auscultation sound is heard in a moist catarrh, the obstruction is usually in the tube.

6. Under ordinary conditions most of the secretion leaves the middle ear via the Eustachian tube.

7. A whistling noise indicates secretion but gives no clew as to the size of the perforation.

A Case of Acute Middle Ear Suppuration, Complicated by Labyrinthine Fistula and Paralysis of the Abducens Nerve.

HASTINGS, Los Angeles (*Archives of Otology*, Vol. XXXV, No. 1.) A man aged 22, whose mastoid had been opened on account of an acute mastoiditis, continued to have increasing pain and discharge from the ear. There was dizziness, vertigo and diplopia, due to paralysis of the abducens nerve on the affected side. Temperature and pulse were practically normal. Twenty-three days after the primary operation the radical operation was undertaken. On removing pus and granulations from the tympanum, pus could be seen coming from the inner tympanic wall, in the recess of the oval window. The fistula was probed and found to lead inward, apparently into the vestibule to a depth of about ½ cm., before bony resistance was met with. The opening was enlarged and the fistula swabbed with a solution of bichloride of mercury. There was no necrosis of any other part of the tympanum. The pain subsided after this operation. The paralysis and diplopia gradually disappeared and the discharge ceased within a week. Tinnitus persisted and the hearing in that ear was practically gone. *Campbell.*

The Diagnosis of Intracranial Complications of Suppurative Ear Disease.

JOHN F. BARNHILL (*Journal American Medical Association*, November 11, 1905) thinks that, in cases of brain abscess, hemicrania is seldom or never wanting, appearing as an early symptom and persisting throughout. It is seldom complained of over the site of the abscess, and may be quite a distance from it, as in one of his cases, in whom the pain was persistent and severe over the region of the frontal sinus of the same side of the head.

Persistent headache in connection with a foul-smelling ear, in which necrotic bone, granulations and cholesteatoma is discovered to be present, should not fail to cause the medical attendant to think of brain abscess. Irritable disposition of the individual has also good diagnostic value. Vomiting is almost certain to be noticed at some time during the progress of the disease. Temperature is usually subnormal and the pulse from 60 to 45. While a chill may occur at some time during the disease, it is certainly not to be compared in diagnostic value to that of sinus thrombosis. *Richards.*

Operative Technic and After-Treatment of Mastoiditis with Epidural Complications.

W. SOHIER BRYANT (*Medical Record,* March 31, 1906) thinks the best results in the way of after-treatment in cases requiring radical operation are obtained by the use of the front bent gouge instead of chisels or other gouges requiring the mallet, as it allows the convalescence to begin more quickly. By closing the mastoid wound and allowing it to collapse and partially fill with blood clot to permit union by first intention, the convalescence is shortened. By allowing the anterior flap of the wound holding the pinna to fall inward and backward and lie on the posterior and inner wall of the wound, the post-aural cosmetic effect is improved. He avoids the packing which causes the formation of a large cavity, requiring a long time to granulate up. He does not regard the exposure of the dura mater as a complication of special importance.

Richards.

Sinus Thrombosis—A Report of Two Cases, with Masked Symptoms.

HILL HASTINGS (*Journal American Medical Association,* November 18, 1905). In Case 1 the sinus thrombosis was a sequela of typhoid fever. The mastoid operation was first done and the sinus examined, and found apparently normal. Temperature pursuing the septic course, the sinus was again examined and opened, when it was found thrombosed at the knee. It was then resected, together with the internal jugular vein. The septic temperature, however, continued and death occurred six days after the resection.

In Case 2 mastoid operation was done by reason of a vague malarial history following an acute aural suppuration, and the sinus was examined in order to be assured that it was normal. It was found, however, to be partly broken down, so curetted above and below until free bleeding took place, recovery resulting. *Richards.*

Peculiar Symptoms Following a Radical Operation.

GEORGE F. COTT (*Journal American Medical Association,* November 11, 1905). In this case, following the operation, the patient had a varying temperature, with fullness of the central retinal veins in both eyes, and preparations were made to operate for sinus phlebitis, that diagnosis having been made. Temperature falling a little each day, operation was postponed, and recovery eventually took place, although there were at in-

tervals slight chills and a temperature varying from 100 to 104.

It is possible that complete thrombosis without general infection took place, and it would seem to the reviewer that there must be many cases in which this takes place, and that the results may be as prompt and quite as good as in some of the cases in which the operation for sinus thrombosis is performed. *Richards.*

The Danger of Operation on the Bulbus—Formation of an Encephalocele.

K. GRUNERT (*Archiv. f. Ohrenheilkunde,* Bd. 64, H. 2 and 3, S. 97). In the course of a case operated on for thrombus of sigmoid sinus, there developed a prolapse of the brain, which gradually increased in size and through a fistula gave exit to large amounts of cerebro-spinal fluid. This gradually decreased under pressure bandage and cauterization with silver nitrate, and finally became almost covered with epidermis. At the time of writing, prolapse had not entirely disappeared. The liquor cerebralis came from the ventricles of the brain. In spite of its large amount, there was no infection. The prolapse was probably due to toxins acting at a distance from site of their origin. Where this site was it is impossible to tell, as patient did not die.

Examination of the Ears of Railway Employees.

R. SACH (*Archiv. für Ohrenheilkunde,* Bd. 65, H. 1 and 2, S. 7) results:

No.	Office.	Normal.	Disturbance. Slight	Disturbance. Severe
155	Trainmen	99—60%	42—32%	14— 8%
115	Firemen	73—60%	30—25%	12—10%
106	Engineers—			
	51, under 35 years...	24—48%	23—45%	4— 8%
	55, over 45 years....	5— 7%	26—47%	24—46%

That is, ear affections are mainly found in engineers whose term of service has been very long. The number who complain of subjective noises is very small, doubtless due to dissimulation, on account of fear of losing position.

The Treatment of Oto-Sclerosis by Means of Phosphorus.

SUGAR (*Archiv. für Ohrenheilkunde,* Vol. 66, p. 36). As the result of an extensive investigation of the indications and dangers in the use of phosphorus, Sugar concludes:

1. The use of phosphorus in the spongification occurring in oto-sclerosis is not scientific.

2. The method by which it is employed is not to be disregarded.

3. The exhibition of mineral phosphorus, especially in the maximum doses for a period of years, causes grave questionings.

4. The employment of harmless organic phosphorus, especially in the form of phytins is to be preferred in all cases.

Harris.

Nasal Auscultation of the Ear During Catheterization of the Tube.

Laval made experiments on cadaver and the living.

1. Sounds arising at the ostium tubae are heard very loud through the nose, but through the ear are indistinct or a sonorous noise.

2. Those arising in tube are heard equally well through nose and ear.

3. Those arising in middle ear are not audible through nose.

A tube was inserted into the nose as far as the beginning of the middle meatus of nose and held by pressing finger against side of nose.

Drawings illustrate course of sound waves in different conditions of tube.

Contribution to the Knowledge of Pneumococcic Otitis.

E. Dallman (*Archiv. f. Ohren.,* Bd. 64, H. 2 and 3, S. 147) reports a case of fatal pneumococcal infection. When seen, had bilateral otitis media with slight periostitis of right mastoid. The symptoms were so mild that operation was deferred for nearly a month, when patient was suddenly seized with convulsions and died in less than 24 hours. Post-mortem showed extensive leptomeningitis and ventricle meningitis. Bacteriological examination showed pneumococci. The mildness of preceding symptoms is in marked contrast to the extensive meningeal involvement. There was almost complete destruction of the mastoid cells on both sides with formation of sequestra.

A Case of Otogenous Cerebral Abscess Healed by Operation.

H. Mygind (*Archiv. f. Ohrenh.,* Bd. 65, H. 3 and 4, S. 279). The tegmen antri and tegmen tympani had been eroded, allow-

ing access of the pus to the dura, but the latter was only slightly affected, and no direct path of communication between abscess and middle ear could be found. The abscess was very small and apparently recent. The first cranial symptom was a confusion of mind lasting about one-fourth hour, accompanied by loss of memory, and followed by sensory aphasia. The cause was found in the third temporal convolution, probably about the middle. Agraphia was also present, as was paraphasia. Another point of interest was the rapid pulse which appeared after the operation and lasted 18 days.

Capital Operations for the Cure of Tinnitus Aurium.

W. Sohier Bryant (*Journal American Medical Association*, December 9, 1905) thinks that carefully selected cases of tinnitus, with the nerve stimulus located in the peripheral end of the auditory nerve, offer a good prognosis for cessation of the tinnitus after the section of the eighth nerve, and that we are called on to recommend section of the auditory nerve if, after appropriate general and local treatment, grave tinnitus still exists, provided the source of the tinnitus is believed to lie in the peripheral portion of the auditory nerve; and that section of the acoustic nerve will be as effective for the cure of aural vertigo as for peripheral tinnitus. *Richards.*

Report of Cases Seen in the Gottingen University Policlinic for Ear and Nose Diseases During 1903 and 1904.

K. Buerkner (*Arch. f. Ohrenh.*, Bd. 65, H. 1 and 2, S. 1). Among other interesting data, is the following:

External ear	27.79%	1322
Middle ear	67.39%	3205
Internal ear	4.82%	229
Main ear	69.28%	4756
Nose	65.34%	1378
Throat	34.66%	731
Nose and throat	30.72%	2109
Total ear, nose and throat		6865

A Characteristic Symptom of Purulent Thrombus of the Superior Longitudinal Sinus.

Gradenigo (*Archiv. für Ohrenheilkunde*, Vol. 66, page 243). This is a fluctuating, painful swelling occurring at the vertex

directly in the median line. It corresponds to one of the foramina emissaria Santorini. The swelling can be filled with either blood or pus. This observation is based on a case of longitudinal sinus thrombosis recently seen by the author where the above condition was present. The history of the case is given.

Harris.

A Sound-Free Room.

ZWAARDEMAKER (*Tydsch. v. Geneesk.*, Feb. 3, 1906) mentioned that there had been made in the attic of the laboratory a small room (2.30 with 2.25 and 2 M. high), the walls of which do not repercuss the sound and into which sounds from without outward cannot penetrate. The first is attained with a trichopiese covering, the second by using six different layers for the wall. The result is satisfactory when no people are on the floor, and no heavy wagons in the street vibrate the entire building.

Blaauw.

Teaching the Deaf Child to Hear.

G. HUDSON MAKUEN (*Pennsylvania Medical Journal*, March 1906). The hearing of the deaf child may be greatly improved by the systematic use of aural gymnastics with the speaking voice used in close approximation to the ear. The training of speech should be carried on simultaneously with the hearing exercises, and the degree of success attained will depend largely on the degree of patience and skill of the teacher.

Richards.

Findings in the Ear of Albinotic Animals.

H. BEYER (*Arch. f. Ohrenheilk.*, Bd. 64, H. 4, S. 273). Animals tested (2 cats, 1 dog) had very little hearing, but were not entirely deaf. The most important findings were degenerative changes in the ductus cochlearis and the organ of Corti. The acoustic nerve was normal except that portion running to the ganglion spirale, it being reduced to a few scattered fibres disappearing at the foramina nervina. The ganglion cells were few and scattered, most numerous in the apex and least in the base.

Technic and Indication of the Extraction of the Hammer and Anvil.

H. NEUMANN (*Arch. f. Ohrenh.*, Bd. 64, H. 2 and 3, S. 167). Author advises local anesthesia by means of injection

of 1 per cent cocain to which 2-4 drops tonogen has been added. The needle is inserted beneath the cutis of the cartilaginous portion of the meatus and shoved forwards under the cutis of the bony part. For complete anesthesia, the entire cutis must be detached. Author reviews technique of and indications for operation.

Psychophysiologic Investigations as to the Value of the Statolithic Apparatus in Orientation by Normal People and Deaf Mutes.

G. Alexander and R. Barany (*Archiv. für Ohrenheilkunde,* Bd. 65, H. 3 and 4, S. 187.) Author tried to find out whether there was any difference in the ability of normal and deaf mutes to distinguish direction of a stroke on the forehead when the head was inclined from its normal position. They conclude that the statolithic apparatus has nothing to do with orientation, as the results were the same in deaf mutes as normal persons.

A Case of Syphilis Hered. Tarda of Both Labyrinths.

Behm (*Archiv. f. Ohrenh.,* Vol. 67, H. 1, p. 74). Sudden deafness is left ear, gradually increasing deafness in right. Treated with mercury inunctions. In one month, hearing for whisper increased to 6 m. in right, 3 m. in left. About one and a half month returned complaining of pain. Left hammer removed on account of adhesions. One year later, sudden loss of hearing in left ear. Inunctions again raised hearing in left to 3 m., at which still remains.

The Technic and Rationale of Bulbus Operation.

A. Iwanoff (*Archiv. f. Ohrenh.,* Vol. 67, H. 1, p. 50) reports two additional cases, one in detail. A fistula was found leading to tip of mastoid. The sinus was discolored, and showed a few granulations. Fluid blood from sinus, ten days later second operation performed in which the bulb was laid bare from above, and found discolored. Jugular vein laid bare 1.2 cm. and whole packed with gauze. Normal healing.

Plasma Cells in Aural Polyps.

R. Hahn and A. Sacerdote (*Arch. f. Ohrenh.,* Vol. 65, H. 3 and 4, p. 300) describe histological structure of polypi. All of the 20 polyps examined showed many plasma cells among

the numerous leucocytes and lymphocytes, frequently in larger numbers than the other cellular elements. They were found most numerous in a zone between the center and periphery of the polyp.

Objective Aural Noises.

E. Vali (*Archiv. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 104) reports a case and thinks that the sound was due chiefly to the clonic contractions of the fibres of the m, tensor veli palatini. It is probable that we do not hear the muscle contractions themselves, but rather that thereby the column of air undergoes movements, which cause the sounds.

Simulation of Sinus Prolapse by Isolated Caries of the Terminal Mastoid Cells.

H. Beyer (*Archiv. f. Ohrenh.*, Bd. 64, H. 4, S. 289). Patient previously operated on for mastoid affection, after some weeks, showed a prominence resembling very closely a prolapsed sinus. A secondary operation, however, showed that it was caused by bluish granulations arising from carious bone.

Contribution to the Knowledge of Acquired Atresia of the External Meatus.

R. Leidler (*Arch. f. Ohren.*, Bd. 64, H. 4, S. 254) recapitulates causes of congenital atresia and gives histories of nine cases. Wherever it was possible, author followed Koerner's method, otherwise he followed Panse's or used a special plastic operation.

A Case of Hysterical Deafness.

J. Thanisch (*Archiv. f. Ohrenheilk.*, Vol. 66, H. 1 and 2, p. 116). Patient had been seen twice for acute attacks of deafness. Awoke one night and could hear nothing. When seen, loss of air and bone conduction. Is still under treatment. Neurotic patient.

Encephalitis and Otitis Grippalis Acuta.

Gerber (*Arch. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 31). Case of multiple paralysis of nerves associated with otitis media acuta. They were V, VII, VIII, IX, X, XI, XII, all in toto or in parte. This was only on one side, and condition was probably as given in title.

Testing of Hearing by Means of a New Phonometer.

A. LUCAE (*Arch. f. Ohrenheilk.*, Bd. 64, H. 2 and 3, p. 155) describes a new phonometer which is his old one much improved. By this, even a whisper can be measured and the loudness of the voice can be measured by means of the excursion of an indicator.

Otogenic Meningoencephalitis Serosa.

STENGER (*Archiv. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 144) reports three cases. Severe intracranial symptoms caused by increase of cerebro-spinal fluid due to serous meningitis. Diagnoses were uncertain. As soon as the fluid was allowed exit, patients got better.

The Use of Words with Diphthongs for Determination of the Acoustical Acuity after the Method of the Three Fractions.

H. F. MINKEMA (*Tydschr. v. Geneesk.*, May 13, 1905) has, in conjunction with Van Heerdt, analyzed the Dutch diphthongs ei, yui, ui, au, and ou, an elaboration of the method of Zwaardemaker and Quix. *Blaauw.*

II.—NOSE AND ACCESSORY CAVITIES.

Lupus of the Nasal Cavity—A Clinical Investigation.

HOLGER MYGIND (*Archiv. für Laryngologie und Rhinologie*, Vol. XVII). In an earlier work the author gave the results of his examinations of the larynx and pharynx of 200 lupus patients. These patients had all been under Finsen's care for lupus of the skin, and had been receiving the light treatment. The author in this article gives the results of his examinations of the nasal cavities of these 200 patients. Of the 200 patients examined 57 were males and 143 females. Under the age of 15, there were 8 males and 10 females; between the 15th and 19th years, there were 14 males and 19 females; between the 20th and 24th years, 16 males and 30 females; between the 25th and 29th years, 6 males and 25 females; between the 30th and 34th years, 1 male and 13 females; between the 35th and 39th years, 3 males and 16 females; between the 40th and 44th years, 6 males and 10 females; between the 45th and 49th years, 2 males and 7 females; over 50 years, 1 male and 13 females. Out of the 200 patients the nose was involved

in 129. The nasal cavities showed either distinct lupus lesions, characteristic cicatrices, or destructive processes caused by previous lupus lesions. Of the 129 patients, 36 were male and 93 female. Of the lupus patients examined there were 64.5 per cent who presented evidence of lupus in the nasal cavities.

Bender who examined 380 lupus patients found only 30.3 per cent of nasal lupus among them; Leloir out of 312 lupus patients, found 20 per cent with nasal lupus, and Holin found that over one-half of the 106 patients examined by him, had evidences of lupus in the nasal cavities. Pontoppidan found nasal lupus in 40 out of 100 patients. According to the above statistics intra-nasal lupus occurs more than twice as frequently in women as in men. This was found to be so in the cases examined by the author in Finsen's light institute. Among the same 200 patients examined for pharyngeal and laryngeal lupus, it was found that the greater number of cases of lupus of the pharynx occurred in the men and laryngeal lupus in the women. Pharyngeal and laryngeal lupus occurs also more frequently in young adults under the twenty-fifth year than in older people. The fact that lupus involving the mucous membrane of the lower air passages is a much more severe form than that involving the nose, and really shortens life, may be the reason that pharyngeal and laryngeal lupus is not more often seen in older people. Nasal lupus does not materially shorten the life of the patient, and is found just about as frequently in old as in young subjects.

Intra-nasal lupus, as a rule, is secondary to the skin lesions. In only thirteen of the author's cases of intra-nasal lupus, the skin of the external nose was not affected in any way, but in every case the skin of the face was involved. The intra-nasal condition is, too, as a rule, not as severe as the skin affection, and may persist for a long period without much destruction of tisue. Primary lupus of the nasal cavities, while extremely rare, does occur, although Moritz Schmidt in his extensive experience has only seen one case. In the 129 cases of nasal lupus reported in this paper the nasal involvement was secondary in every case.

The nasal vestibule and the region of the alae nasi is almost always involved. In only 7 of the 129 cases there was no evidence of lupus in the nasal orifices. In a number of cases the alae nasi had been entirely destroyed, causing a good deal of deformity.

Lupus nodules were frequetnly found in the septum, and in a few cases the septum itself was destroyed, causing a sinking and depression of the end of the nose. Cicatrices resulting from the destruction of tissue produce frequent changes in the shape of the nares, consisting frequently in narrowing of the nasal openings. This is produced by a uniform contraction of the cicatricial tissue and cicatrices.

Occasionally the nasal opening is entirely closed by the contraction of this scar tissue. The fact that such frequent deformities were found, and comparatively few cases in which lupus nodules were present in the anterior part of the nose, proves that the lupoid process in this part of the nose runs its course very rapidly, and is much more destructive than in other parts of the nasal cavities. Further in the nose lupus nodules occur with much greater frequency. The nasal septum is very frequently involved. In only 35 of the author's 129 cases was there no evidence of an existing or previous lupoid process of the seputm. The lesions are almost always situated on the cartilaginous septum, and practically never attack the bony septum. This is one of the most important points in the differential diagnosis between this affection and syphilis. In a small number of cases, 24, the lesions on the septum consisted exclusively of lupus nodules; in the remainder of the cases the characteristic scars and perforations were present. The lesions, as a rule, are bilateral. Perforations resulted in 58 of the 129 cases, and as a rule there were no nodules around the edges of the perforations. The perforations are usually situated well anteriorly, and vary in size from small pin point perforations to a perforation involving the entire quadrangular cartilage. As a rule, they were from 1 to 2 cm. in height.

The mucous membrane of the inferior turbinate showed lupus nodules in 80 cases, but visible scars were only present in 3 cases. This is due to the fact that nodules involving this part of the nasal mucosa may persist for years without breaking down. The middle meatus is only rarely involved, and nodules were only found in the mucous membrane of the middle turbinate in 16 cases. The posterior nares were only found involved in 5 cases, which proves an earlier investigation of the author's to be true, that lupus seldom extends directly from the nasal cavities to the mucous membrane of the naso-pharynx and pharynx.

Theisen.

A Case of Nasal Tumor.

H. A. Boon (*Tydschr. v. Geneesk.*, Feb. 3, 1906) presented a man who came under his care Sept. 26, 1904, for headache and obstructed right nose. This obstruction had begun two years before, when an ophthalmologist treated him for an obstruction of the nasolachrymal duct. A firm tumor fills the right nose which can not be seen on posterior rhinoscopy; the external nose is broadened; no swollen lymph nodes. Two weeks after operation, obstruction relieved; patient had much pain during the operation and lost much blood. Operations for obstruction were repeated at intervals, shorter in duration. Regional lymph nodes-swelling appeared; weight went down from 60 to 51.5 Kg.; patient became so weak that he could no longer come to the office. Diagnosis is changed to carcinoma or sarcoma. Narath operated on October 31 by opening the right nares externally, removing the tumor from the septum and concha media and the ethmoidal cells. The operation lasted three-quarters of an hour. Healing per primam; nine days later patient was home again. Swelling of lymph nodes and obstruction of the nasolachrymal duct healed without further treatment; his strength quickly recovered. No return up to the present. Microscopic examination, as in the beginning, showing no indication of malignancy.

Boon also found in two out of three cases of nasal tumors that the malignant character was not discovered microscopically: (1) A boy of 17 years, who died after ten months from a tumor which had invaded all parts in the vicinity of the nose, with large conglomerates of lymph nodes in the neck; twice no malignancy was found in parts removed. (2) A mass was removed from the nose of a woman 38 years of age. Symptoms disappeared for one month. Microscopically "lymphoma" was diagnosticated. She died after being under treatment for eight months from an extensive, quick-growing recurrence.

In cases as the one presented, early radical removal externally is indicated as long as the tumor is localized, even if the microscope does not demonstrate malignancy. The cosmetic result is no contra-indication, as can be seen on the patient.

Quix thought that the operation could have been performed endonasally with, of course, better cosmetic result.

Moll did not oppose external operations.

Boon replied that the cosmetic result is very fine. To operate endonasally was impossible, the sudden breakdown of the patient making radical interference necessary.

The Rational Treatment of Multiple Suppuration of the Cavities of the Nose, with Demonstration of a Cured Patient.

V. Delsaux (*Tydschr. v. Geneesk,* Feb. 3, 1906) operated on a 32-year-old patient, who was suffering from chronic suppuration of the right antrum, frontal sinus and ethmoid at the same side. He began with an incision from the middle of the brow along the margin of the orbit, around the inner canthus along the side plane of the nose, finishing in the naso-labial fold. The soft parts were pushed aside, the frontal sinus opened at its lower portion and curetted. The os nasale and ascending branch of the superior maxilla were then resected, opening the nasal cavity widely. Then the antrum was opened at its internal superior and anterior angle, its anterior and inner walls removed and the antrum carefully scraped out. The ethmoid as far as diseased was removed. The entire cavity was now tamponed, the nose replaced and the wound closed. Healing per primam. Removal of the tampons after two days. Complete cure.

Delsaux related four other cases, concluding: To be radical, the operation must make possible the survey and curettage of all accessory sinuses; the entire mucous membrane of nose and its cavities, including all turbinates, must be removed systematically. If this interference is thought serious, we should remember that these multiple suppurations may be harmful, and in that they are a continuous menace to life by fatal complications within the skull cavity.

Posthumus Meyes did not understand why it was necessary always to remove the inferior turbinate.

Delsaux replied that the inferior concha has nothing to do with the frontal sinus, but when the antrum is diseased, it is better to remove it on account of the likelihood of recurrences. Delsaux stated in reply to Zaalberg's question that he operated in double-sided suppuration by turning the nose downward, but as he was not successful he advocates a double incision.

Braat asked about the length of time of the tamponade; Killian leaves them usually in a short time, only two or three days.

Delsaux removes them at the second day, as they produce granulations and suppuration. Sikkel does the same.

Ocular Symptoms of Affections of the Accessory Sinuses of the Nose.

W. C. Posey (*Journal of the American Medical Association,* September 9, 1905) finds many disturbances of the eye to be in intimate relationship with affections of the accessory sinuses. Among these are disturbances in vision and visual field, changes in the orbit, affections of the lachrymal apparatus, of the lids, of the conjunctiva, of the cornea, of the pupil, of the uveal tract, cataracts, errors of refraction, asthenopia, headache and neuralgia.

The headaches of sinusitis occur usually in the morning and are characterized by continuous pain with severe exacerbations which radiate around the orbit and within the zone of distribution of the fifth nerve; or they may take the form of a general head pain, of facial neuralgia or of toothache. Injection of the conjunctiva, lachrymation and photophobia are often present. Its location is significant, and is generally sufficiently characteristic to enable one to differentiate the particular sinus affected.

Neuralgia of the supraorbital nerve is very significant of frontal disease, and dental neuralgia will frequently indicate the existence of antral disease. Frontal headache is suggestive of ethmoidal and frontal disease, while occipital pain is usually caused by sphenoiditis, though disease of the frontal sinus may evidence itself in pain in that locality also. Pain in the vertex and at the back of the eyes is usually caused by sphenoiditis, though, on account of the close proximity of the fifth nerve to the lateral wall of the sinus and the nearness of the sphenopalatine ganglia, reflex pain to any part of the head may be occasioned by disease of that cavity. A distressing pain across the bridge of the nose is peculiar to ethmoid disease.

Richards.

Turbinectomy.

E. Harrison Griffin (*Medical Rcord,* April 14, 1906) thinks partial turbinectomy should be done whenever the inferior turbinate is in contact with the septum, and only sufficient should be removed to establish natural breathing. He saws from below upwards, removing it in such a way as not to hinder its power as a functionating organ.

On account of secondary hemorrhage, he has ceased using adrenalin. Instead he gives, for ten days to two weeks before the operation, two grains of quinine after each meal and ten

grains at bedtime, and with the bedtime dose twenty grains of potassium bromide in solution. This will reduce the chance of a hemorrhage to a minimum. When the patient first applies for treatment, the turbinate will be found a dark red in color, very much swollen, and the canal much narrowed by the swollen membrane encroaching on its lumen. Examination after a week's treatment with quinine and the bromides will show the membrane much reduced in size and of a much healthier color.

At the time of the operation he plugs the nose with a long piece of absorbent or plain antiseptic cotton, about six inches in length, the major part of which is removed the following day. When the patient is given ten grains of quinine and twenty grains of potassium bromide, he finds secondary hemorrhage very rare. The internal treatment with the quinine and potassium bromide is continued for two or more weeks after the operation.

It would seen to the reviewer as though this was an excessive amount of quinine, and would be more than many patients could comfortably take. *Richards.*

Two Cases of Osteoma of the Ethmoid.

H. De Stella (*Tydschr. v. Geneesk.*, Feb. 3, 1906) was called to examine the nose of a 17-year-old girl, who had consulted the ophthalmologist for proptosis with diminution of the visual acuity. He found the left nose filled with hard, bony tumor, which pressed against the septum and projected into the naso-pharyngeal cavity; behind it was free and attached to the ethmoid. The left naris had been closed for years. He made the diagnosis of osteoma of the ethmoid and considered removal through resection of the upper jaw impossible, so he operated, as Moure, with an incision along the supraorbital margin and the side of the nose as far as the upper lip, with removal of the nasal bone and the outer wall of the antrum. After the operation the bony walls of the orbit were pressed in, the eye replaced and the wound entirely sutured. Healing in two weeks, position of the eye normal, nose free, recurrence not to be expected.

His second case, a boy of 21 years old, was also sent him by the ophthalmologist, who was consulted for exophthalmus and diminution of sight for six months at the left side. A hard, bony tumor was found at the inner side of the orbit, ap-

parently originating from the lachrymal bone. In the nose there were deviation and spur of the septum, but no tumor. In the eye there was advanced retinitis atrophica. The incision was made as in the first case, the bulb pushed outward and the tumor cut off from the ethmoid. The wound healed quickly.

Blaauw.

The Submucous Resection of the Septum Illustrated.

WILLIAM L. BALLENGER (*Pennsylvania Medical Journal,* March, 1906) offers the following axioms in connection with this operation:

Make haste slowly in starting the elevation of the mucoperichondrium. Any other manner of haste is liable to result in a permanent perforation.

Do not extend the Killian incision through both mucous membranes, on account of the danger of perforation.

Introduce as few instruments as infrequently as possible between the membranes.

Do not "fish" for what you want, but look, see, feel, comprehend, then remove what you want. "Fishing" in the cavity is liable to tear the mucosa.

A sharp-pointed instrument in a cavity is a dangerous thing. A dull one is safer.

The mucoperichondrium is easily and quickly lifted with a blunt elevator in 95 per cent of all cases.

The external ridge of the nose needs support, hence, leave plenty of cartilage in this region for this purpose.

Do not operate to straighten the septum, but rather to remove obstructive lesions of the septum, and with a view to the patient's comfort and permanent relief.

The article is illustrated pictorially, and should be carefully studied by anyone desiring to do the operation, who has not already acquired satisfactory technic. *Richards.*

Three Cases of a Foreign Body in the Antrum.

P. TH. L. KAN (*Tydschr. v. Geneesk.,* Feb. 3, 1906) reported the following three cases:

1. A piece of straw 3 cm. long was found on making a radical operation on the left antrum for chronic fetid suppuration. Four years ago the antrum was opened through the alveolus, and patient not being able to smoke, as no prothesis was used, closed the opening with different things.

2. A revolver bullet, which perforated the septum anteriorly from the left side and reached the right inferior turbinate 1 cm. behind its anterior extremity and then passed into the antrum. The bullet would have been expected, from its course in the nose, to be at the bottom of the posterior wall of the antrum, but it was found after chiselling away the anterior wall of the antrum, half in the ethmoid cells, half in the antrum, while the right lamina papyracea was pressed outward. Kan supposes that the bullet reached so high up because the woman threw her head backward, as in resistance to the shot.

3. Also a revolver bullet in the right antrum of a 41-year-old man, who tried to commit suicide by shooting into the left temple. The bullet went through the left lobus temporalis and left orbit—without injuring the bulb—the left ethmoid and middle turbinate; perforated the septum, and reached the right antrum through the inferior turbinate. Kan saw patient seven weeks after the accident and found a broad synechia between middle turbinate and septum in the left nose. A radiograph showed the bullet in the antrum, which was removed after opening the anterior wall; there was no suppuration present.

Blaauw.

Transplantation of Bone for the Relief of Saddle-Nose.

CULLEN F. WELTY (*The Journal of the American Medical Association*, November 11, 1905). The saddle-nose was due to an injury occurring two years before. There was some obstruction of the nasal cavities, which was first corrected. An incision starting just below the union of the nasal bones was carried well into the tip of the nose, cutting down to the cartilage proper, separating the perichondrium in the hope that the implanted bone would form union at this place. At either end of the incision, the skin and fascia were undermined so that the bone could not be displaced. The skin and fascia from the sides were likewise dissected loose as these tissues were drawn tight over the bridge. A piece of bone two inches long and the thickness of half a lead pencil was then removed from the crest of the tibia, and with it more than enough periosteum to cover it. Its edges were trimmed with a pair of scissors and it was then adapted to the cavity in the nose which had been made for it, and the wound closed with deep sutures. The periosteum of the tibia was sutured with catgut and the skin with silk. No pus appeared from either wound. The result was satisfactory. *Richards.*

Foreign Body in a Syphilitic Nose.

P. TH. L. KAN (*Tydschr. v. Geneesk.*, May 13, 1905) found a piece of guttapercha, 5 cm. long, and 4 cotton wads, enclosed in a discolored odorous mass, in the nose of a patient, in whom the entire bony and cartilaginous septum had been destroyed and the palate perforated by syphilis. A physician had given this to him in 1878 as a prosthetic appliance for his perforation. *Blaauw.*

III.—MOUTH AND PHARYNX.

The Significance of Edema of the Pharynx.

J. E. SCHADLE (*Laryngoscope*, February, 1906). The association of edema of the pharynx with acute nephritis, the author states, is a rare observation, and deserves mention on account of its clinical importance.

An epidemic of tonsillitis that prevailed in St. Paul is described. Adults and children were affected alike. The tonsillitis was of follicular variety, and was no doubt infectious in its nature. Its toxic character was shown by such complications as cervical adenitis, a low form of continued fever, general debility and subsequent anemia. Convalescence was slow, and evidently retarded by systemic poisoning. A study of the disease made it apparent that the tonsillar tissue served as a portal for bacterial invasion of the lymphatic glands and the general circulation. Albumin was not uncommonly found in the urine, and in a certain percentage of the cases, active inflammation of the kidneys was induced and formed a grave aspect of the disease. Acute exudative follicular tonsillitis is not always a local disease per se, and as is well known may extend beyond the throat, and through its toxic influence involve organs more or less remotely situated. For this reason, persons suffering from this form of tonsillitis should receive the most guarded attention. As is well known, edema may be local or general, circumscribed or diffused. The writer desires to call special attention to edematous infiltration of the pharynx. This is a rare affection, and is of special significance and interest and, as is illustrated by the history of the following case reported by the writer, the condition bears a significant relationship to acute nephritis.

E. M. W., aged 70 years. During convalescence from a sharp attack of influenza, patient's temperature suddenly rose to 103° F. with chill, and he presented the usual signs of quinsy, the left tonsil being affected. Under treatment the local lesion and fever subsided in 48 hours. On the following day the temperature rose to 101.6 and he developed suddenly a brawny swelling at the angle of the left jaw. A few days later symptoms of dyspnea suggested a laryngeal edema, but on examination of the throat the larynx was clear, but there was a marked edema of the pharynx. The left side of the pharynx was much swollen, and the lymphatic glands of the neck on the same side were greatly enlarged and painful on pressure. The swelling in the throat extended downwards toward the larynx, and across, anteriorly, toward the base of the tongue. The conclusion arrived at was to the effect that the condition was either an edema pure and simple, or that there was pus deeply seated either in the neck or throat. Deep incisions were made into the pharyngeal tumor, but no pus was obtained. A serous fluid issued from the incisions, and gave the patient temporary relief from the difficulty in breathing he had been having.

On examination of the urine, a large amount of albumin, and casts, were found. The result of this examination appeared to the writer to give a satisfactory explanation of the cause of the local phenomena appearing in the throat and neck. He considered that the patient had been suffering from an infectious nephritis brought on by an attack of tonsillitis.

After the kidney lesion disappeared there was no return of the pharyngeal and lymphatic complications. *Theisen.*

Concerning Periodic Recurring Hemorrhages from One Tonsil Directly Before the Beginning of Menstruation.

M. Wunsch (*Deutsche Medicinische Wochenschrift*, No. 38, 1905). The following case is reported: A young woman, aged 25 years, consulted the writer for the relief of bleeding from the mouth, which came on directly before each menstrual period. The patient herself noticed that the bleeding came from the right tonsil.

An examination of the throat showed on the right tonsil a small blood cot. There was no ulceration of the tonsil, nor was it enlarged. The throat in other respects was perfectly normal.

Menstruation was regular and of a normal type. Vicarious

hemorrhages in women from the nose, stomach, lungs, from hemorrhoids and wounds have been frequently described. Hesch describes a case of fatal hemorrhage from the lungs, which he attributes to vicarious menstruation. Kidalen describes vicarious menstruation in cases of defective development of the uterus.

Rheinstein has reported a case from the mucous membrane of the Fallopian tubes.

In the majority of the cases the menses are absent or scanty. In conclusion, the author states that hemorrhages from a perfectly intact tonsil are so rare that the report of his case was of some interest. *Theisen.*

A New Instrument for Removal of Hypertrophied Tonsils With the Cold Snare.

J. G. Henkes (*Tydschr. v. Geneesk.,* Feb. 3, 1906) uses the cold snare in a sort of forceps which enables one hand to produce enough force to pull the snare through the tonsil, the operating hand being under the mouth of the patient. The steel wire must be thin and tough. He used it with 150 patients, 107 of which were under 5 years old; the bleeding was minimal and the wound healed in general sooner than with the tonsillotome. It is the instrument of choice for little children (made by Wilh. Walb, Nachf., Heidelberg).

Zaalberg used the Henkes' snare with four children; twice it went all right, once the blade was loose, once the wire broke. He prefers the forceps of Ruault.

Henkes states that the screws must be well connected and the right kind of wire chosen. When the snare does not cut, the wire is too thick. *Blaauw.*

A Case of Tonsillolith.

H. J. L. Struycken (*Tydsch. v. Geneesk,* Feb. 3, 1906), removed a tonsillolith from a patient, who had before spontaneously removed small pieces. A firm, hard tumor was in the soft palate over the left tonsil, from which, after incision, the stone was removed; it was 2.5 cm. long and 1.5 broad and thick. *Blaauw.*

Governmental Inquiry as to the Frequency of Adenoids in School Children.

H. Burger (*Tydschr. v. Geneesk.,* May 13, 1905). In September, 1903, the Minister of the Interior sent a letter to all teachers connected with the primary education asking their

co-operation in finding out the number of sufferers from adenoids among the school children. They received a pamphlet, wherein the important symptoms were described, and they were asked to state the number affected. For these the following report was to be made: 1. Whether they breathe through their mouth while sitting; 2. During sleep; 3. Whether they complain of headache; 4. Whether they are behind in their class; 5. Whether they speak with a nasal voice; 6. Whether they stutter; 7. Presence of deafness; 8. Of earache; 9. Presence of the disease in brothers or sisters. The result was that some 6 per cent of all school teachers were supposed by the teachers to suffer from adenoids.

No public discussion would have been held as to these preliminary results, if the president of the Central Sanitary Council had not asked this body for advice.

The Sanitary Council wished information about 4 questions, to which 15 members of the society responded.

1. Did more children come under treatment in 1904 than in the previous years, supposed to suffer from adenoids? Can it be stated in per cents? Ten members answer affirmatively, one giving an increase of some 30 per cent.

2. Were more patients treated for adenoids in 1904 than previously? Can it be stated in per cents? Fourteen members answered in the affirmative; one did not see any increase. The increase varied from a slight percentage to even 60 per cent. The interest of the public was clearly shown, partly due to the late Prof. Guye's agitation of the question, partly because this condition was brought before the public, even in the parliament.

3. Have many of these sufferers been sent by the teachers? Can it be stated how many of their suppositions were correct? All members but one affirm. Only two could give a percentive relation. In one case the teacher had sent 18 children, 12 (66.7 per cent) of which had adenoids; the other member found half of the cases to be sufferers of adenoids, or enlarged tonsils with or without adenoids (of the other 50 per cent, 30 per cent had a narrowing of the nose, 20 per cent no anomaly whatever, or mouth-breathing through other more distant causes).

Burger mentions his experience with a school for backward children. Its head, Mr. Schreuder, takes particular interest in this topic; his supposition was right in 23+13=36 times (67 per cent) and wrong 10+8=18 times. Of these 63

children, 40 suffered (63.7 per cent) from adenoids. Although the teachers showed a varying spirit, some only looking for the open mouth, others for headache or backwardness in learning, coloring the statistical tables accordingly, it can be thankfully acknowledged that a very great number of children in different parts of the country are recognized as sufferers from adenoids and are cured under proper treatment.

Burger considers examination with the finger only allowed with school children, when the parents give their consent. Mirror examination is most to be recommended. With posterior rhinoscopy three degrees may be distinguished: in the slightest, the swelling reaches or just passes the choanal arcs; in the second, it reaches the superior third of the choanae; in the highest degree, a large part of the choanae, half or more, is covered by the adenoids. From 15 to 20 per cent, however, of the children can not be examined in this way; these must be excluded from the statistics. Taking together 11 tables of statistics, including 13,283 children, adenoids were found in 30.2 per cent (4,014); these statistics are all based upon direct examination of the naso-pharyngeal cavity; 3.3 per cent were found suffering from speech defects and abnormal facial expression; 16 per cent in subjects where all external signs, including acoustical acuity, were taken into account. This shows that the external signs are entirely insufficient as a base for statistics of adenoids, as a very large number of the cases, possibly, four-fifths or nine-tenths, remain undiagnosticated.

4. Does experience show, after removal of adenoids, great amelioration of symptoms which could be of disadvantage in the future life of the patient? Nine hundred answered in the affirmative, only one said "no" without further explanation; so that we may conclude that a large experience has demonstrated the amelioration of symptoms, which are of considerable interest from out a social standpoint. Deafness is most important. Of the 2,303 adenoid cases treated between September, 1896, and January, 1903, in the dispensary at Amsterdam, 56.4 per cent (1,299) suffered from catarrh or inflammation of the middle ear. Deafness, disturbed sleep, headache, aprosexia diminish not only the vital pleasure of the children, but they prevent—in very different degree—their intellectual formation, and can be cured in a large percentage immediately and permanently. The development of the body may also greatly suffer; disturbance in the development of the thorax, chronic tracheal and bronchial catarrhs, asthmatic con-

ditions, anemia, general debility, early fatigue, want of cheerfulness, great susceptibility, small resistance power, bad temper, poor appetite; these are a part of the disturbances mentioned by different writers, more or less properly as caused by adenoids. The examination of the blood shows a slight anemia and leucocytosis, which becomes normal after removal. The hemoglobin has been found less than normal and also the alkalinity of the blood. Adenoids may produce all symptoms of scrophulosis, which removal cures.

Efficient removal of the adenoid vegetations in the first years of school life must, from a social point of view, constitute, without doubt, an important gain in health and active power of the people. Systematic guidance of the public is of great importance, also regular instruction of the teachers connected with primary instruction is necessary. At present insufficient help comes from the physicians themselves, as they are in the main uninstructed in the pathology of throat, nose and ears. With a better understanding on the part of the general physicians, many years will still pass before this will influence the recognition and relief of the adenoids. Therefore school-physicians are necessary who have a special study of school hygiene, dermatology, ophthalmology and oto-rhinology.

In the discussion, Zaalberg stated that with Ten Cate he began an investigation in the public schools of Amsterdam. Digital examination was not permitted, but the number in which rhinoscopia posterior fails is small. They examined one school with 500 pupils. Of the 252 boys 32 per cent of the 248 girls 34 per cent, had adenoids. They distinguished as to the degree "much," "moderate," "little," and "a trace." The pupils were designated by the teachers as "bright," "moderate" and "with small progress." Of the 67 bright boys 14 per cent, of the 135 moderate 17 per cent, of the 47 small progress 21 per cent (average 17 per cent) had "much" adenoids. Of the 46 bright girls 4.3 per cent, of the 146 moderate 14.5 per cent, of the 57 small progress 24.5 per cent had "much" adenoids.

Burger replied that a typical distinction between hypertrophy of the pharynx tonsil and adenoids is not made at present, as no real difference exists whether the hypertrophy has the shape of a tumor or of more separate lobes. Only a small number of the adenoid cases are recognizable by the external signs. It is a mistake to think that only those external recognizable cases should have a pedagogic and sociologic interest.

Blaauw.

IV.—LARYNX.

The Observation and Photography of Speech Sounds.

H. J. L. Struycken (*Tydsch. v. Geneesk.*, Feb. 3, 1906) showed an instrument wherewith sound vibrations, transferred through the air, can be observed with an enlargement of 600 times. With a very strong illumination (sunlight) and quicker rotation-oscillation of the total reflecting prism, waves can be observed produced by tones of even more than 20,000 vibrations. The speech sounds also, vowels as well as consonants, can be easily seen even when spoken at a distance of a few meters. The curves, even of the most simple vowels, show a thousand different changes in form; during phonation slight changes of the structure continually takes place.

The curves may be photographed, but the enlargement must then not be over 200 times with an illumination of 1/30000 second.

Struycken tried to solve, in the following simple way, the problem of accurate determination of the time: a fine elastic hair is fixed to one prong, which hair begins to vibrate with an amplitude 10 to 50 times larger than the prong itself, as can easily be demonstrated experimentally. It makes the same number of vibrations as the prong, but is nearly always in phase contrast. This hair is put at the light side of the very small slit, which intercepts the enlarged image of the vocal waves. The cylinder lens transforms the shadow line into a shadow point, which draws a curve on the film with macroscopically visible amplitude, while the vocal waves are taken undisturbed at the side. The very small, narrow tuning fork, to which the hair is fixed, vibrates only very weakly, so that the air waves made by it cannot influence the structure of the vocal curves. Next to each other and, independently, sound curve and sinus line of the tuning fork come on one film. If necessary, an almost perfect certainty of 1/10000 second may be reached when the tuning fork has a normal of 3000 vibrations a second.

This method can be used with profit for observation of speech sounds, for comparison of pitch, for comparison of the amplitudes at different distances and at different pitch, even for measuring the sound velocity at very short distance.

Zwaardemaker deplored that the speaker held his instrument

under cover. He does not consider it well to demonstrate and hide at the same time instruments and methods. The largest merit of the method here shown is the reproduction of very weak sounds photographically. He knows of only one other instrument which does the same: the string galvanometer of Einthoven.

Quix considered it unheard of to demonstrate an instrument under canvas. So the experimentum crucis fails. He had a great objection against analyzing vibrations of a membrane. One never knows how much of the reproduction corresponds to the speech sounds.

Struycken replied that the instrument is very frail. The covering did not hinder the sound-waves and served to stem the air current. He considers it pretty certain that the vibrations observed are really sound-waves, as for each pitch always a proportionate number of waves is observed.

Blaauw.

Demonstration of Mirrors for Endolaryngoscopy.

Th. E. Ter Kuile (*Tydschr. v. Geneesk.*, May 13, 1905) had a mirror made wherewith he can inspect in a sagittal direction the inside of the larynx. With the ordinary mirror one looks in a rostrocaudal direction and sees only along the posterior wall. With Killian's method we look in many cases obliquely at the posterior wall, especially at its superior part. His new mirror can be called "posterior wall-mirror" and is made by H. Pfau, Dorotheenstr, 67 Berlin, N. W. The reflecting plane is an oval of 14 by 9 mm.; the large axis is here in the vertical direction, the small one in the transversal one. The larynx is made anesthetic with 20 per cent cocain. The ordinary mirror is placed at the uvula and then the posterior wall-mirror put in. In case the epiglottis hangs over too much towards the posterior wall the patient must phonate, when the mirror will easily pass this barrier. The epiglottis is then further fixed by the vertical part of the handle of this mirror anteriorly. While the posterior wall-mirror slides downward we see successively the posterior wall of the pharynx entrance of the esophagus, the upper border of the arytenoid region with the incisura santorini, then the mucous membrane of the posterior wall and still deeper that of the cricoid cartilage which appears white. The advantage of this method is that the posterior wall is seen in normal position; the image in no

way is reversed. If the posterior wall-mirror is turned around, the angle between the posterior and lateral wall of the larynx may be seen, which the ordinary laryngoscope does not show. The most striking are the upper border of the posterior wall of the larynx with the incisura santorini and the mucous membrane of the posterior wall of the pharynx, which is somewhat paler, often with transverse streaks. The mirror must be turned to the right or left when the noduli santorini is to be seen. To see the cricoid, the larynx must be well cocainized. The mirror is the most useful for those cases for which it was made, viz., where there is question as to the presence of an ulcer on the posterior wall of an otherwise normal larynx. The diagnosis is also facilitated between subacute swellings of the mucous membrane of the posterior wall and beginning chronic ulcerative tuberculous and luetic processes of the larynx.

Blaauw.

A Case of Congenital Laryngeal Membrane.

ZALEWSKI (*Fränkels Archiv.*, Vol. 16, No. 3). Cases of congenital diaphragm of the larynx are so rare that the author considered the following case well worth putting on record:

The patient, a man aged 25 years, came to the clinic in Lemberg, complaining of difficulty in breathing, which troubled him particularly when he walked or climbed hills. Hoarseness was also present. The distressing symptoms had been worse for a year, but the patient stated that his voice had never been clear.

He had never suffered from lung or throat troubles, and had a good family history. Laryngeal examination showed the presence of a membrane in the anterior part of the larynx, under the vocal cords, which filled the larynx, with the exception of a small round opening posteriorly. The cords themselves merely showed the evidences of a slight chronic laryngitis. The movements of the cords were normal. It was found, when an examination was made with a laryngeal probe, that this membrane was thin and rather elastic, extending posteriorly two-thirds the length of the vocal cords, and appeared to be adherent to their under surface. Other than this, the larynx did not show any pathological changes. The author removed the membrane endo-laryngeally, with Störks' double pincette. The voice became clear immediately, and the difficulty in breathing was also at once relieved. The author believes

that this was undoubtedly a congenital membrane, because it was situated in the place where they are usually found, and because no other changes that could account for the formation of the membrane were found in the larynx.

Very little is known concerning the origin of these congenital membranes.

Hansemann considers that they may be due to an intrauterine inflammation of the larynx. Other investigators consider that they are anomalies of development. Only operative procedures are indicated in treating such conditions.

In the majority of the cases, endo-laryngeal operations can be performed with cocaine. In cases, however, where the membrane is very thick and tough, laryngo-fissure may have to be performed. Fein has collected only sixteen cases of this interesting condition from the literature. *Theisen.*

Measuring of the Intensity of the Voice.

H. F. Minkema (*Tydschr. v. Geneesk,* Feb. 3, 1906) refers to the experiments of Wolf in 1871, and of Lucae, who made his phonometer in 1872 for determinating of its intensity. In Band. 64 of the *Arch. f. Ohrenheilk.*, Lucae gives an improvement of his instrument, which records the amplitude of a glass membrane, which is moved through air currents produced during whispering. The vocals and consonants p, b, œ, o, weak in an auditory sense, give the largest amplitude. Words which begin with explosives should, therefore, be used with this instrument.

Reuter made such an investigation with the anemometer, where he got a measurable amplitude only with œ, o, p, b.

Minkema investigated the whisper voice-currents with a simple tube of Pitot. This tube was connected with an aerodromograph and the velocity of the air thus registered. It is clearly shown that only œ, o, ui, ou, p, b, f, give expression to amplitude; with the whispered s, a negative amplitude was produced, probably by air vortex.

Zwaardemaker determined with the aerodromograph the intensity of the singing voice; the expended energy swung between 0.45 and 0.95 megaerg.

Minkema tried with the phonograph to calculate the intensity of the voice. He used the results of the analysis of Fourier of the word "een." *Blaauw.*

Improved Clipping Forceps for Removal of Growths of the Vocal Cords.

H. J. L. STRUYCKEN (*Tydschr. v. Geneesk.*, Feb. 3, 1906) finds that the usual forceps have the following disadvantages: (1) The cutting end moves in those where the beak is pulled in a tube to close them. (2) The entire forceps moved when the handle is pressed in those which open with a hinge. (3) Those without these disadvantages cut in a horizontal plane, so that the growth can only rarely be well grapsed, and those which cut vertically have the lower bill dull and broad, which makes it very difficult to introduce it between the vocal cords in the anterior commissure. (4) It is generally impossible to see in the mirror which part really is grasped between both jaws of the beak.

Struycken hopes to overcome these disadvantages with his forceps: (1) The forceps possesses the three-ringed handle of Pfau, which keeps the beak in place while it is closed. (2) The upper jaw is fenestrated so that the part grasped may be seen; it is placed at an angle of 20° with the horizontal plane downward, so that the forceps, when it is kept a little oblique becomes nearly horizontal. (3) When the opened beak is introduced, the inferior jaw is vertically downward and its point goes easily between the vocal cords and keeps to the anatomic relations in closing. (4) The beak cuts from below upward and entirely through, that is, without dead space (it is never necessary to tear); it is movable in every position vertically and can be made in all sizes. *Blaauw.*

Keratosis Laryngis Circumscripta.

I. C. HENKES (*Tydschr. v. Geneesk.*, May 13, 1905) showed a 13-year-old girl, who came under his care for hoarseness. Her voice has not been more clear since her 6th year, at present, it is almost aphonic; there is no cough; general health good. The false vocal cords are slightly swollen. The vocal cords have tumor-like new formations on both sides, somewhat anterior to the vocal processes, which originate with broad base from the free margin and stand out into the glottis. They are of a light-yellow pink color and a firm consistency. The anterior third part of the vocal cords shows the same intumescences but smaller. On phonation these growths press on each other and fit in as the teeth of a cogwheel. Patient suffered from psoriasis universalis inveterata since her second or third year. *Blaauw.*

Three Rare Laryngeal Tumors.

W. Posthumus Meyes (*Tydschr. v. Geneesk.*, Feb. 3, 1906) demonstrates:

1. A firm, knotty, oblong tumor, in section 3.5 and 2 cm., which was found with the laryngoscope adherent to the right pharyngeal wall with a thin pedicle, almost closing the entrance of the larynx. The patient was 64 years old, healthy-looking, complaining of increasing difficulty of swallowing solid food for a year; no dyspnea, speech perfectly clear. On palpation the tumor was found hard, uneven, movable and painless, while the attachment to the pharyngeal wall was harder than the surrounding tissue into which it passes in a regular way. A distinct infiltration can be felt externally in the neck, without glandular swelling in the surrounding tissues. The diagnosis was made of a malignant newformation, carcinoma or sarcoma and the tumor was removed with the galvano-cautery snare, with slight bleeding. Dr. Driessen made the microscopic diagnosis of sarcomatous-carcinoma. A recurrence of the size of the original tumor formed within eight weeks, with enlarged externally palpable swelling and some hard lymph nodes. Prof. Lanz performed pharyngectomy.

2. A semi-globular, firm tumor of the size of a small egg, weighing 28 grains, removed from a boy 8 years old, who became gradually affected for a year and a half with attacks of suffocation; the child was emaciated on account of dysphagia and very cyanotic. A severe inspiratory dyspnea was present as if from serious larynx stenosis. On opening the mouth a tumor was seen moving up and down with every respiration, glossy, quite smooth and pale, which seemed to close the pharynx from all sides with every inspiration. The tumor could be palpated without pain as far as the aditus ad laryngem, and was connected with a thin pedicle to the inner right undersurface of the epiglottis. Meyes tore the pedicle with his finger; bleeding was insignificant. The mirror showed a bleeding spot at the base of the epiglottis near the right crico-arytenoid articulation; the larynx was normal otherwise. Macroscopic appearance and microscopic examination confirmed the diagnosis of lipoma. The pharyngeal wall was everywhere atrophic where contact had existed with the tumor, as if polished by the rubbing of the tumor. Patient entirely recovered.

3. A pale, smooth, broad-pedicled tumor of the size of a pigeon egg, removed the day before from the throat of a child 16 months old. The mother had noticed when it was 4 months

old that it had a pedunculated tumor in the throat, which sometimes lay on the tongue, and when it was invisible the child was very much oppressed. The family physician should have removed it by tying off the pedicle. Since then child remained healthy, until some months ago, when deglutition became more difficult. Inspection shows between pharyngeal wall and soft palate a projecting whitish globular tumor, which entirely fills the left part of the cavum pharyngo-nasale. On palpation the tumor is smooth, pseudo-fluctuating, movable, with a thick pedicle connected high up with the posterior left side of the soft palate. The peduncle was tied as high as possible and removed with a cold wire snare. Macroscopic section shows a lipoma.

Blaauw.

V.—MISCELLANEOUS.

Radiography of a Tracheal Stenosis (through Enlargement of the Thymus).

H. J. L. Struycken (*Tydsch. v. Geneesk,* Feb. 3, 1906.) examined the patient first at the age of two years, for symptoms which made the physician suppose some croup process was prescent. Struycken did not find any membrane on autoscopic examination, but he thought that a tracheal polypus under the glottis produced a stenosis; on expiration the lumen closed almost entirely, and the air passed well during inspiration. Inferior tracheatomy did not relieve the symptoms, but relief followed the introduction of an elastic catheter with evacuation of a very large quantity of muco-pus. A canula was introduced and well retained. The general condition improved rapidly, but the dullness over the manubrium sterni remained. The diagnosis remained wavering between thymus hypertrophy, lymph node swelling, malignant newformation or vessel ectasia. Looking along the tracheal wound the posterior wall was seen to bulge into the lumen, the cartilaginous rings were weakened somewhat, 4 cm. beneath the upper margin of the manubrium sterni. With every expiration this wall pressed against the opposite side, which had given before the impression of a polyp. Fever and vessel sounds were absent; careful puncture externally to the trachea was without result.

During the past 4 years the dullness increased, but diminished during the last half year. At the place of dullnes a distinct shadow can be seen by means of radiograph, made by Dr.

Bynen, Jr. Notwithstanding the canula, the child can speak well and its general condition is satisfactory. The parents altogether opposed more radical treatment. *Blaauw.*

A Distinct Type of Respiration with Asthma, According to Photographic Pictures.

TEN HAVE (*Tydschr. v. Geneesk.*, Feb. 3, 1906) examined a number of normal persons and five asthmatics with Zwaardemaker's aerodromometer (small aluminum disc hung up in a vertical respiratory tube between two spiral springs). With these latter he found, without exception, a distinct altered respiratory type, which is not found in the usual respiration of normal people. Notwithstanding that respiration is somewhat slower and but slightly deeper than normal, the expiration of the asthma sufferer, outside of paroxysms is of such a nature that the velocity of the current quickly reaches a certain maximum in the first half of the expiratory phase, and decreases again directly and remains small during the second half. Although it is a known fact that expiration mostly is clearly lengthened in asthmatics and emphysematous patients, this demonstrated particularity of the respiratory current had not been observed by the investigators. It is very manifest in the motions of this aerodromometer followed chronophotographically, just as with the aerodromography demonstrated in 1904, because the recordings of these instruments represent somewhat exaggerated the changing velocities of the air current. The aerodromograph (demonstration 1904) gives records proportionate to the quadrants of the velocities.

Blaauw.

The Use of Thiosinamin and Fibrolysin in Otology and Rhinology.

L. HIRSCHLAND (*Archiv. f. Ohrenheilkunde,* Bd. 64, H. 2 and 3, S. 107). Author reports previous findings of others in regard to thiosinamin and describes a more recent preparation called fibrolysin (first reported by Mendel in *Therapeut. Monatsh.,* Feb., 1905), which is a double salt of thiosinamin and sodium salicylate. It is easily soluble in water, but decomposed in the light, so it is put up in small brown pearls, each containing 1.5 cm. of fibrolysin in 8.5 cm. of water. Remedy can be given like thiosinamin, either internally, subcutaneously, intramuscularly or intravenously, efficiency increasing in order named. Author used ½ Praraz syringe of 10 per

cent solution, thiosinamin in glycerin, 3x in first week, 6x in second week and 6 whole syringes in third week. The action requires more or less time to make its appearance. Cases of labyrinthine or nervous deafness, in very old people, artereosclerosis and cases of otitis media with ossification, are not adapted to the treatment. Even if hearing is not increased, tinnitus is usually improved. The treatment must be coupled with the ordinary mechanical treatment. The use of thiosinamin or fibrolysin is devoid of danger. *Blaauw.*

Post-Diphtheritic Palsies and Serum Injection.

H. De Stella (*Tydschr. v. Geneesk.*, Feb. 3, 1906) demonstrated in 1904 that injected serum does not remain long in the blood, but is absorbed by the cells and tissues, even when they produce the poisons or when the poisons are already present. They are neutralized by the antitoxin only when the connection is made within a quarter of an hour. Still, according to the French, serum injection is advocated for post-diphtheritic palsies. De Stella was convinced that it can do no good here, as it cannot break the connection of poison with the protoplasm. He therefore experimented with two groups of rabbits of nearly the same size and weight, in which he produced paralysis through injections of diphtheritic poison. Five days after the last injection, he took ten rabbits of group A and injected them during five and ten days with serum, and left ten rabbits of group B undisturbed. He did not find the least difference in the healing of the paralysis of the rabbits of group A or B. *Blaauw.*

A Foreign Body in the Right Bronchus, Removed by Means of Bronchoscopy.

P. Th. L. Kan (*Tydschr. v. Geneesk.*, Feb. 3, 1906) treated a 6-year-old girl, who had aspirated a bean two days ago; the oppression slowly increased; brought in the hospital she could breathe only in sitting posture. There were distinct changes on percussion and auscultation over the right side. As the size of the bean was unknown, tracheotomy was performed; a tube 15 cm. long and 9 mm. in diameter was introduced and a bean, impacted in the right bronchus, could be seen covering the bifurcation. Only a crescent-shaped slit remained for the air to reach the left bronchus. On pulling at the trachea or bending the head backward the slit became so narrow that

suffocation symptoms appeared. He seized it with a sharp hook and removed this together with the tube. The hook held only a part of the shell. The tube was reintroduced and the hook pressed in deeper. Removal of the instruments now was successful; all troubles disappeared and patient entirely recovered.

Blaauw.

Lipoma of the Esophagus.

P. TH. L. KAN (*Tydshr. v. Geneesk.*, Feb. 3, 1906) found this rare tumor on a 66-year-old woman. She had but slight trouble from the tumor, which she could bring in the mouth by a movement of tongue and pharyngeal walls. When she swallowed the tumor, it could not be seen laryngoscopically. She had a large subcutaneous lipoma on her neck. She was operated on twelve years previously for the same kind of tumor. The place of origin of the tumor could not be made out. Radiographs were made after a lead bullet was attached to the tumor and patient had swallowed both, but on the plates no shadow of the bullet could be found.

Prof. Korteweg removed the tumor per vias naturales with a pair of forceps, by which the pedicle was grasped and twisted. The specimen fixed in formol was 5 cm. long with a width and thickness of 2 and 1.5 cm.; it consisted chiefly of adipose tissue. Kan believes that the place of origin must be looked for in the superior part of the esophagus.

Prof. Zwaardemaker stated that instead of the lead bullet bismuth pellets could have been used.

Foreign Body in the Bronchus.

H. H. GERMAIN (*Journal of the American Medical Association,* July 8, 1905). Child of twenty-one months inhaled a peanut kernel. Tracheotomy was done without relief, and nine days later without anesthesia, No. 25 French endoscope introduced through the tracheotomy wound, and a half kernel of peanut could be seen in the right primary bronchus. This was easily removed with a pair of alligator forceps. Tracheal canula left in place forty-eight hours, then omitted at intervals. Severe bronchopneumonia followed, but there was no expiratory dyspnea after foreign body was removed.

Richards.

XXX.

THE RESULTS OBTAINED FROM THE RADICAL OPERATION FOR CHRONIC PURULENT OTITIS MEDIA.*

By S. MacCuen Smith, M. D.

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In accepting the invitation to discuss the subject of this paper, my understanding was that a review of the writer's personal experience was desired, not a critical examination of the literature on the subject. My first thought was to give in tabulated form the more or less complete notes of about two hundred operative cases, but the time allotted to papers will not permit of this lengthy discussion, so we will reserve this for a future paper.

With the possible exception of acute mastoiditis and the indications for operating thereon, no other subject in otological literature has elicited more thorough investigation and discussion by the best intellects in the profession, than that dealing with the various methods at our command to combat successfully the ravages of a chronic suppurating ear. Many of us are familiar with the extensive opposition formerly encountered when the operation under consideration was advised. To this very antagonism, however, we, as well as the public in general, are greatly indebted, for it seems to have acted as a stimulus, irresistible in character, to further the dauntless courage and incessant labors of the few pioneers, who builded even better than they knew.

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*Read at the 12th Annual Meeting of the American Laryngological, Rhinological and Otological Society, Kansas City, Mo., June, 1906.

Enthusiasm, properly directed, is essential for the successful promotion of almost any radical change or advancement. This is true, especially, in its relation to conservative medicine. The enthusiastic advocate of a new surgical problem, therefore, occupies a very important place in the actual advance of medical science, for although this earnestness may carry his measure beyond the line of prudence, or even safety, thus simulating what may be termed frenzied surgery, he will soon be brought to a proper realization of its worth, by running counter to the apathy of the ultra-conservative element of the profession, and all that pertains to its correcting and beneficial influence. It is the middle ground, the compromise that those two extreme elements eventually adopt, that will prevail. The subject of this paper has passed through the various stages above enumerated, and we are now settling down to a well-defined, rational conception of the disease and its remedy.

Not long since, it appeared that our success in curing a chronic discharging ear by means of the radical operation made it incumbent upon us to adopt this method of treatment indiscriminately; more recently, however, a healthy reaction has become quite manifest, and we are again disposed to resort to ossiculectomy and tympanic curettement as an efficient means of relieving suppurating ears of a definite character. Indeed, it is the writer's belief and teaching that the minor operation should first be employed in the large class of cases where mastoid or other intracranial complications are not suspected, or where symptoms do not demand the immediate adoption of more radical measures. On the other hand, however, it must be remembered that a great majority of the serious complications, both intracranial and general, incident to such a condition, arise from the chronic form of disease; moreover, some complications, such as brain abscess, may have actually existed for some months, or even for a period of years, without producing symptoms peculiar to their kind, apparently without cause, or perhaps following slight injury to the head. These abscess formations suddenly give rise to most alarming phenomena, which must always be viewed with grave apprehension, inasmuch as the symptoms are frequently so ill defined as to render a correct diagnosis impossible. No doubt many of us have been subject to the keen mortification of operating on a suspected temporo-sphenoidal or cerebellar abscess without having

our diagnosis confirmed by the findings, and yet, all the antemortem symptoms indicating the diagnosis as made were sustained by neurologists and general surgeons of ability, whereas the autopsy revealed the lesion to be located in another part of the brain.

Mention of these facts is made for the purpose of again calling attention to our faulty and misleading methods of determining brain localization in lesions arising from diseases of the organ of hearing. Furthermore, the above will serve to illustrate in a forceful manner the one cardinal point, the chief factor indeed, in dealing with all classes and varieties of pus formation and necrotic changes occurring within the temporal bone, namely, to strive to eradicate the disease by whatever means may be necessary, before any of the more serious complications have time to develop. The discharge of pus from any part of the ear must be regarded as a daily menace to the health and life of the individual so afflicted; this truism is not in any sense modified by knowledge of the fact that cases have been observed to exist for many years without the development of serious complications.

This brings us to a consideration of the best means of treating cases of chronic suppurative otitis media. First, however, it is well that we recall the indications for the radical operation, inasmuch as it is now generally conceded that the more simple method should first be employed in selected cases.

Notwithstanding this fact, however, a thorough and exhaustive analysis of every detail of the subject will establish the unalterable conclusion that the radical operation is the only satisfactory method that can be adopted in the vast majority of cases. This conclusion is so convincing that even the most skeptical and ultra-conservative are ready converts to its utility, when brought in actual contact with the results.

In this connection the writer is forcibly reminded of a certain percentage of cases subjected to the radical operation, in which the discharge does not cease within a reasonable time, or having once stopped, is subject to relapse. At one time these annoying cases were quite numerous, but as the technique of the operation improved, and the deftness and understanding of the surgeon developed, these cases have grown less and less with each succeeding year, so that the necessity for secondary operations has been reduced to a minimum. The chief causes for these re-

lapses were incomplete or faulty operations, especially in relation to undiscovered necrotic cells of the zygoma and the mastoid tip, as well as reinfection occurring from the Eustachian tube; at the present time we would consider these sources of autoinfection mostly preventable. In considering the indications for performing the radical operation, we must not lose sight of the important fact that the attic, the aditus and the antrum are integral parts of the tympanic cavity and usually share in its infections. This fact alone explains why so-called suppurative otitis media cases become chronic and remain so, and furthermore, shows the folly of protracted efforts to relieve a condition that cannot possibly be reached through the external canal. We must earnestly endeavor to impress upon the mind of the profession this one fact of vital importance, namely, that the discharge escaping from the external canal is nothing more than a local manifestation of the necrotic changes occurring within the mastoid antrum and lower cells or the cranial cavity, and that the middle ear cavity and auditory canal through which it passes are important chiefly as a safety valve or means of exit for the overflow pus. In other words, it must be observed that a dense bony wall separates the external canal from the actual site of the disease, the only communication being the narrow opening connecting the tympanic cavity with the mastoid antrum.

In this connection, therefore, we again wish to call attention to the extreme folly of adopting any line of treatment which at best can have little more for its object than cleanliness of the external parts. In no possible way can the cases under consideration receive benefit by the application of such measures, and we should lose no opportunity to effect the proper recognition and conception of these facts.

Broadly speaking, the writer believes it is not only wise, but urgently imperative, to perform the radical operation in all cases that do not yield to the more simple measures within a reasonable time; and as the duration of time in this connection can be applied only in a relative sense, we must, after all, depend on our good judgment in determining the proper time to operate; a sane judgment should develop with experience, with which there is usually associated a peculiar intuition, always more or less difficult of explicit interpretation, but which may be safely followed. From time immemorial, the presence of pus in any part of the economy has been considered the most potent

foe of the human race; this is especially true when confined within a cavity, the integrity of which must sooner or later yield to the ever increasing pressure caused by the accumulation of inflammatory debris and the necrotic changes incident thereto. Why these sound surgical principles as applied to a more or less blind cavern as the mastoid process should be viewed with such an unusual sense of apathy, especially when we recall the vital structures immediately adjacent thereto, is difficult to comprehend, except that knowledge of the unusual danger likely to be encountered forbids a prompt acceptance of such responsibility. However, it is just this hesitancy, this procrastination, this putting off until the morrow, that invites additional complications and frequently their fatal termination.

We encounter cases of either acute or chronic suppuration in which a carious fistulous opening eventually penetrates the mastoid cortex, giving rise to periostitis and the classical symptons of mastoiditis. These patients on account of the formidable objective symptoms become alarming to the attending physician, but this ocular manifestation of the disease is decidedly favorable rather than unfavorable, as it indicates that the direction of the inflammation is external rather than internal. It is those cases of tenderness, however slight, on deep pressure, without external evidence of deep-seated mischief, that are of much greater import, indicating as they do that the direction of inflammatory involvement is inward.

As stated in the beginning, the scope of this paper will not embrace a review of literature, of which there is much, worthy of profound consideration, but to these general remarks will be added a few personal observations and conclusions.

The operation in the majority of cases has no detrimental effect upon the hearing. If any change at all is brought about by the operation, it would be for the improvement, rather than impairment, of the function of hearing. On the other hand, however, we must not lose sight of the fact that occasionally we find a case that will be positively made worse by the operation. I have never been able to give any explanation of this fact. Hankins (Australasian Med. Gaz., Vol. 24, 1905, p. 199) says: "I think there is every prospect that before long the results will so improve that it will be justifiable to operate with a view to increasing the hearing power, impaired by long suppuration, which may at the time have ceased." This enthu-

siastic statement, however, had perhaps better be qualified by the provision that one should determine definitely whether the impairment of hearing in a given case is due to tympanic disease or to labyrinthine involvement. As epidermization progresses we usually find some impairment of hearing, as the skin covers the tympanic cavity, this part being usually the last to be covered.

Injury to the tympanic branch of the facial nerve is not frequently encountered at the present time, owing to the improved technique. However, we find in some cases a facial palsy of mild degree occurring several days after operation. This may be accounted for by the formation of an inflammatory exudate with the Fallopian canal which always disappears within a very short time under the influence of electricity. Other possible injuries, such as injury to the jugular bulb, semi-circular canals and the sigmoid sinus, are all very infrequent occurrences.

A point to which I wish to call particular attention is the frequency with which we find a carious opening through the tympanic roof, which the writer has reason to believe is often overlooked, and inasmuch as it is a source of drainage for an extradural and also a temporo-sphenoidal abscess, the importance of discovering this opening is manifest. It is frequently too small to provide for proper drainage and must necessarily be enlarged. The writer believes this to be one of the frequent causes of prolonged suppuration following the radical operation.

It is most important that both the malleus and incus, and especially the latter, should be removed at the time of operation. On account of the deficiency of nutritive vessels supplying the incus, we are inclined to feel that it has become disintegrated and discharged in the form of pus, but a more careful search will frequently discover it in some portion of the tympanic cavity, and if overlooked must necessarily be the cause of an indefinitely continued discharge.

As regards skin grafting, in the early days of the radical operation, the writer attempted the various methods of skin grafting, but in later years he has abandoned this procedure entirely from the fact that virtually any of the complications following the radical operation have occurred in those cases in which he had attempted skin grafting. The only benefit that can be derived from skin grafting is the questionable claim that it shortens the length of convalescence. However,

by following the line of treatment which will be detailed presently, we feel that the results are better and more quickly obtained and that thorough dermatization is accomplished in much less time than when skin grafting was resorted to.

The character of the discharge is a matter of the greatest importance in determining the necessity for immediate operation. A continued foul-smelling secretion always indicates necrotic bone and this in turn requires operative interference. The writer believes that the presence of the pneumococcus, streptococcus or the bacillus of influenza in the discharge, or the presence of cholesteatoma in the ear is an absolute indication for the radical operation, as in his experience these microorganisms have been found either singly or as a mixed infection in practically all of the intracranial complications. He further believes them to be chiefly responsible for the extensive carious involvement of either the middle ear or mastoid.

On account of the obscurity of such cases to the uneducated eye, they are allowed to progress on their deadly mission, day by day, week by week, or month by month, until eventually life is destroyed without the ear, the primary or underlying cause, being suspected. The chief object of the present medical age would seem to be the prevention of disease, but it is not entirely complimentary to a learned profession, vested with the rights and responsibilities of conserving the public health, to manifest such utter disregard for the prophylaxis of certain diseases of the ear. It would not be possible for such unsanitary conditions to prevail in any other branch of surgery, which indeed compare favorably with the discreditable seton age, when a knotted string was pulled through an enlarged gland for the purpose of its dissipation. Modern surgery demands the prompt eradication of pus, necrotic tissue and all other inflammatory debris wherever located; the ear and its accessory cavities can no longer be the one conspicuous exception.

As we now recognize that more than ninety per cent of all brain abscesses are traceable directly to aural disease; that practically all cases of sinus thrombosis are due to the same cause, and upon further reflection are reminded of the numerous cases of meningitis and other serious general ailments that complicate diseases of the ear, it should be our constant aim to convert the widespread apathy that tolerates the existence of so large a number of secondary diseases, many of which are positively preventable.

The limits of this paper will not admit of even touching upon the technique of the operation, except to state that, however perfectly we may execute every surgical detail, our final results will not be that which might reasonably be expected, unless we are prepared to personally conduct the after-treatment; the absence of this personal care will account for many of the slow recoveries.

It may be of interest to relate somewhat in detail the line of post-operative treatment which the writer has followed for some years, by means of which, furthermore, he has secured very satisfactory results. The chief object of this method of treatment consists in keeping the propagatory surface dry, inasmuch as heat and moisture favor the rapid multiplication of microorganisms. The dressing applied at the termination of the operation is not disturbed for a period of from five to seven days, at the end of which time the packing is removed and is not again reinserted. The ear is then syringed with a 25 per cent solution of hydrogen peroxide, then normal salt solution, and this is followed by a 10 per cent solution of alcohol, the latter being gradually increased in strength until absolute alcohol is used. After syringing as above stated, the entire ear cavity is carefully and thoroughly dried under good reflected light, then a powder composed of equal parts of aristol and boric acid is liberally insufflated over the entire cavity; the same powder is also placed over the mastoid incision and the dressing applied. This method of treatment is applied every second day until the discharge has markedly decreased. The frequency of subsequent dressings will be governed by the amount of discharge.

A modification of this line of treatment will consist in cleansing the canal with the above solutions by means of the cotton wrapped applicator in cases where there is only a scanty discharge. This modification is especially applicable to cases after the first two or three weeks, at which time the discharge has greatly decreased.

With this method of treatment it is the exception to find the appearance of exuberant granulation tissue. This is particularly true and worthy of special mention in treating syphilitic and tuberculous cases in which the tendency to granulation tissue is very marked.

XXXI.

THE RESULTS OBTAINED FROM THE RADICAL OPERATION FOR CHRONIC PURULENT OTITIS MEDIA.*

By Edward Bradford Dench, M. D.,
NEW YORK.

Owing to the frequency of chronic middle ear suppuration, and the fatal results which so often follow this condition, if it is left uncontrolled, it is no wonder that the radical operation for the cure of chronic middle ear suppuration has been greatly exploited during the past decade. The true value of any surgical procedure can be determined only after the operation in question has been in vogue for a number of years, thus giving an opportunity for the ultimate results following operative interference to be decided upon definitely.

The results obtained by the operation in question, may be considered under the following heads: 1st, the efficiency of the operation in protecting the patient against intracranial suppuration; 2nd, efficiency of the operation in causing a permanent cessation of the otorrhea; 3rd, the immediate and remote effect of the operation upon the function of the organ, and 4th, the effect upon the integrity of the facial nerve.

I have upon my books at the present time records of 193 operations of this character. In none of these patients, so far as I know, has there been any evidence of an intracranial lesion after the suppuration has been relieved. We may say, therefore, that the radical operation certainly does protect the patient from the dangerous sequelae of middle ear suppuration.

When we come to consider the matter of the permanent relief of the otorrhea, the results obtained by this procedure are, perhaps, not as flattering as we had hoped they would be when the procedure was first suggested.

Out of 193 cases, there are 131 cures, 29 with slight discharge, 5 with profuse discharge, 2 still under treatment, 6 fatal cases, and 20 cases in which the result was unknown.

*Read before American Laryngological, Rhinological and Otological Society, Kansas City, June, 1906.

In going over these results more in detail, if we take out the 20 cases in which the result is unknown, we have 173 cases, of which 131 are cured, or a little over 75 per cent. Out of the last series of 95 cases, the cures amount to exactly 80 per cent, in those cases in which the results are complete. In the last series of cases, in no instance did the discharge remain profuse after the operation, all of the cases being either dry or presenting but a slight discharge from the meatus. Of the 6 deaths, two patients died of pneumonia, two of meningitis, one of cerebral abscess, and one of cerebellar abscess complicated by sarcoma of the auditory nerve. In no instance could death be attributed either directly or indirectly to the operation.

Of those cases which were operated upon several years ago, and which have been followed carefully, the results have been most satisfactory. Even where a small amount of discharge has persisted for weeks or even months after the operation, this discharge has in almost every instance disappeared absolutely, without the necessity of secondary interference, under simple measures of cleanliness.

Even in those cases where the cure has been considered perfect, it is not uncommon to have the patients return, at intervals of from four months to one or two years, complaining of some discharge from the external auditory canal. An examination will show the entire cavity filled with a mass of desquamated epithelium, upon the removal of which a small amount of pus may be found. If this accumulation has remained in the canal for a considerable period of time, desquamation of the epithelial lining of the cavity may have taken place either completely or over certain areas. On removing the epithelial mass, the cavity certainly looks far from healthy, and one unaccustomed to this condition, would certainly say that the radical operation had been a failure. If the cavity is simply sterilized with an alcoholic solution of bichlorid of mercury, and then dusted with some bland, non-irritating powder, such as boric acid, xeroform, zinc oxid, or, in fact, any sterile powder, the cavity immediately becomes dry. In other words, the apparent relapse in so many of these cases is due simply to the fact that the integument lining the middle ear cavity and the mastoid cells, is improperly nourished. This integument forms the lining of a blind pouch where it is sub-

jected to increased temperature, increased moisture, the absence of light, and no circulation of air, these latter conditions being essential to the proper nutrition of the normal skin. Moreover, it must be remembered that this tegumentary lining is applied closely to the bony walls of the cavity, with veiy little connective tissue substance intervening.

It is not strange, therefore, that desquamation should take place from time to time, in such a cavity, and that the desquamated epithelium, if allowed to remain in position, should gradually accumulate until the cavity becomes completely filled with these epithelial cells. The production of these cast-off cells causes superficial ulceration of the underlying tissue, so that complete desquamation of a cavity of this kind frequently takes place. These attacks of desquamation of the cavity occur less and less frequently as time goes on, because the integument gradually adapts itself to its new habitat, and in the course of time is able to conform itself to its anomalous position.

These attacks of desquamation should not be looked upon as a recurrence of the otitis. As before stated, they are easily relieved by the removal of the epithelial detritus, and the sterilization of the walls of the cavity.

When the radical operation was first proposed, and, I am sorry to say, even at the present time, many surgeons hesitated to advise the procedure for fear of impairing the function of audition, as the result of operative interference. In the series of cases in which I have advised this operation, I can state that in but very few instances has the hearing been made worse by the procedure.

Out of 111 cases, in which the hearing records were kept, the hearing after the operation was good in 99, was fair in 9, and was bad in 3. By "good hearing," I mean hearing where the whispered voice was heard anywhere from 5 feet to 15 feet, and by "fair hearing," where the whispered voice was heard from 6 feet to 3 feet, or 4 feet. In the 3 remaining cases, where the hearing is recorded as "bad," the hearing was worse than before the operation.

If the operator exercises caution in his manipulation, and is careful neither to dislodge the stapes, nor to impact it in the oval window, he can promise the patient almost certainly that the hearing will not be greatly interfered with as the result

of the operation. This remark applies to those cases in which the hearing is considerably impaired before the procedure is undertaken. Given, for instance, a case of chronic middle ear suppuration, where the low whisper is heard at a distance of 10 feet, in such a case, impairment of the hearing might follow operation. With a whispering distance of 3 or 4 feet, however, the hearing would hardly become impaired as the result of the operation, while the chances of improvement in the hearing would be considerable.

I have a number of cases at the present time under observation which were subjected to the operation a number of years ago. In these cases, the hearing has steadily improved, owing probably to a gradual mobilization of the stapes by sound waves. In those cases, therefore, where no labyrinthine lesion exists, as evidenced by careful functional examination, and where there is a moderate impairment of hearing prior to operation, the surgeon need not hesitate to advise the procedure for fear of impairing the function of the organ. The hearing is more apt to be improved by the operation than to be impaired by it.

Referring to those unfortunate cases where a partial or a complete facial paralysis results from the operation, either immediately, or where it supervenes at the end of a few days, I can only say that in my own experience, the function of the facial nerve has ultimately been restored in every instance. Out of the last 95 cases operated on, facial paralysis occurred in 4 instances, and in every instance, the function of the facial has been restored.

Of the series of cases previously reported, the exact number of instances in which the facial was involved, is not definitely known. (Transactions of the 7th International Otological Congress, Bordeaux, 1904.) I should say, however, that secondary paralysis occurred in about the same proportion of cases in these two series. In those cases where facial paralysis comes on at the end of two or three days after the operation, the function of the facial nerve is usually restored at the end of two or three weeks, although I have seen several months elapse before power was completely restored to the facial muscles. In those cases, where facial paralysis comes on immediately after the operation, the period before complete recovery takes place is often long. Here six, seven,

eight, or even more months may elapse before all evidences of facial paralysis disappear. If, however, the facial nerve is not completely severed at the time of operation, I believe that its function will be entirely restored in the very large proportion of instances.

Where facial paralysis does occur, it is best treated by daily applications of either the galvanic or faradic current, the galvanic being used where the muscles do not react to faradic stimulation. Where the muscles react to faradism, the faradic current is to be used. In addition to the use of electricity, the administration of strychnin internally, seems to hasten the restoration of the function of the nerve.

You will understand that I am speaking now simply from my own statistics, and in no single instance have I seen, in my own cases, permanent facial paralysis follow the operation.

So much for the ultimate results obtained in these cases. Certain questions have come up in regard to the technique of the operation, which may perhaps be discussed here.

First, the advisability of primary grafting.

Second, the advisability of secondary grafting at the end of five to ten days after the primary operation.

Third, the advisability of the introduction of grafts through the canal.

Fourth, anomalous methods of healing after skin grafting.

There is no doubt in my own mind as to the advisability of employing large skin grafts for lining the bony cavity formed during the radical operation. It is true that all of these cases will recover, and will recover quite as well if skin grafting is not employed. From a considerable experience, however, I am absolutely certain that the period of convalescence is shortened if skin-grafting is employed, either as a primary procedure or from five to ten days after the original operation.

Out of the last 95 cases, primary grafting was employed forty-eight times. The grafts did not take in every instance, but in at least 75 per cent of the cases the grafts adhered, either in part or throughout. The application of either primary grafts or of secondary grafts certainly shortens the convalescence.

Regarding the advisability of applying grafts through the external auditory meatus, this procedure has been advocated by a number of writers. I have employed this method in but

one instance. Here the result was satisfactory, but here also, the external auditory meatus had been very greatly enlarged by means of a plastic operation. I do not think that the application of Thiersch grafts through the external auditory canal is applicable to a very large proportion of cases, and I prefer, therefore, to apply the grafts either at the time of the first operation, or to do a secondary operation for the purpose of grafting the wound through the posterior opening.

As to whether the skin graft is to be inserted at the time of the primary operation, or at a later date, will depend somewhat upon the choice of the operator, and very largely upon the pathologic conditions found at the time of the operation. If the case operated upon is what may be termed an "interval" case, that is, if there are no symptoms of acute suppuration, if there is but little fluid pus in the mastoid antrum and mastoid cells, and if neither the dura or sinus is exposed at the time of the operation, I believe that primary grafting should be the rule. The fact that either the sinus or dura in the middle cranial fossa is exposed at the time of the primary operation, does not necessarily prevent the operator from lining the interior of the cavity with a skin graft, provided the sinus and dura seem normal. Care should be taken, however, that the grafts be applied only to those parts of the middle ear not in the immediate vicinity of the exposed sinus or dura. Where the sinus has been exposed, it is my invariable rule not to close the posterior wound completely, but to insert a small gauze drain over the sinus and bring it out at the inferior angle of the wound. This gauze drain is removed at the first dressing, and may or may not be replaced, according to the condition found. In cases which are particularly foul, that is, where the mastoid cells are found to contain fluid pus, or where the necrosis is extensive, I seldom employ primary grafts. In these cases the posterior wound is not sutured. The plastic operation on the auricle is done, the posterior wound packed and the case dressed first on the third or fourth day. After this time, it is dressed daily until healthy granulations are found lining the entire radical cavity. Any time from five to ten days will be a favorable time for grafting upon these granulations. Of course, after the secondary grafting, the posterior wound is completely sutured.

There is one method of healing which has been observed in

a number of cases that have been grafted primarily. In certain instances, it is unwise to apply the grafts over the entire bony cavity, owing either to exposure of the sinus over a limited area or exposure of the dura. In cases where the cavity is partially grafted, and the remainder allowed to heal by granulation, the grafts may become incarcerated in the granulation tissue; that is, if the graft is applied to the fundus of the bony cavity and not to the walls, granulations may spring up from the walls, and for a time almost completely hide the grafted area. As these granulations are controlled, however, the fundus of the canal will gradually appear, and the graft will be found in place and adherent, and the fundus dry.

Another condition which is sometimes met with, is an adhesion between the upper wall of the operation cavity and the facial spur. In cases where the middle cranial fossa lies very low, it is sometimes impossible to prevent this adhesion from forming. On examining the ear we find the radical cavity divided into two parts by a septum or partition, a posterior portion, made up of the mastoid cavity, and an anterior portion comprising the atrium and vault. In some instances, this septum may extend nearly to the meatal opening. We seldom find the ear perfectly dry while this septum is present. If simple cleanliness is observed, however, the septum gradually disappears, and after an interval of from three to nine months after the operation, the entire radical cavity will be found to have resumed its proper form. In one instance, I remember that this septum so obstructed drainage, that it was thought a secondary operation might be necessary. Simple division of the septum and packing the wound with gauze, brought about a complete and permanent cure.

I have attempted to present the results following operation, as clearly and concisely as possible. The paper simply embraces a study of my own cases, and does not deal at all with the experience of others.

DISCUSSION.

Dr. Norval H. Pierce, Chicago, in opening the discussion, said he wished to speak of the changes in audition after operation. He believed that the following tests should always be made before operating: that is, first the whisper test; second, the test for low sounds; third, bone conduction and

lateralization, and fourth, Rinné's test. In this way we may ascertain whether there is stapes ankylosis or nerve degeneration. He has been surprised to find how often the auditory nerve is affected in suppurative ear disease; whether this was due to absolute invasion of the labyrinth by the suppurative process, he felt himself unable to say, but when one is sure it has invaded the labyrinth its course is very different. Where there has been no stapes ankylosis and no nerve involvement before operation, the audition has been improved, or unchanged.

Dr. Charles W. Richardson, Washington, said in regard to the operation, that he had had about a half dozen cases of facial paralysis coming on after the operation. All of these cases were now ancient enough to have completely and absolutely recovered. He recalled attention to the fact that he applies no packing after the primary packing has been removed. He thought it one of the most satisfactory operations that he knew of; it gave good results. His results had all been satisfactory. He called attention to a case he had operated upon recently in which a web had been found between the superior wall and the facial ridge. It was let alone and is now gradually disappearing. He had cavities where the granulations nearly filled them up, which latterly become capacious as the cicatrization takes place. Dr. Dench had told him that in his experience webs usually break away and clear up.

Dr. E. M. Holmes, Boston, said more positive results could be obtained in this class of cases than in any other. Regarding the facial nerve, he related one interesting case of a girl of about 35 who had facial paralysis for 13 years. He operated on the mastoid on the right side, and after completing the operation a large chestnut could have been placed in the cavity. The case went along nicely, but the facial paralysis persisted. She returned a month ago with considerable power on that side of the face. Doctor Lund had performed anastomosis between the hypoglossal and facial nerves. Unless she laughs, the paralysis is unnoticeable. Regarding the skin flap, for four years he has been performing an operation in which his first incision is carried through the skin only. It is dissected forward, not injuring the periosteum. The posterior superior portion of the cartilaginous canal is severed

near its attachment to the bony canal and the auricle is carried forward. With a small angular knife an incision is carried through the skin and periosteum of the bony canal at about the junction of the superior and anterior quadrants above, and the posterior and inferior quadrants below. Between these an incision is carried just outside the annulus. An incision is also carried through periosteum of the mastoid from the incision of the superior portion of canal backward over the temporal line. From the outer end of the lower incision in the canal the periosteum is incised on a line toward the mastoid tip. The periosteum is carefully elevated from the canal and mastoid, that from the canal is covered by the skin of the canal. The flap of skin and periosteum is rolled back and covered with moist sterile gauze. After the mastoid and middle ear have been exenterated, all rough bone is smoothed so as to leave a gradual slope, and the periosteal-skin flap is adjusted. The auricle is carried to place and fastened with gut sutures. The wound is closed and sutured and a gauze pad applied so as to keep the skin in contact with the periosteum. A tube or wick is inserted in the auditory canal and the usual bandage applied.

Dr. W. C. Phillips, New York, said he would like to discuss three or four points, and the first one was that related to the fatalities following the radical operation for chronic suppuration of the middle ear. The reader of the paper relates six fatalities, and the speaker wished to emphasize the fact that while fatalities were few and may usually have no special connection with the operation, the fact remained that they did ensue. At the Atlantic City meeting two years ago, he had reported two fatalities following the radical operation. It was discussed by a number of men, everyone of whom reported from one to three cases. Since that meeting, two more fatalities had occurred in the speaker's practice; one of them the result of a brain abscess of long standing, which was discovered only at the time of the operation, and which, after evacuation, rapidly developed a general septic meningitis, and the other a case of purulent meningitis, both of which he expected to report in full. The brain abscess was an old one and had no doubt been in a quiescent state for many months. Another question, that of facial paralysis, should not be underestimated. From what he had seen and

heard, facial paralysis, usually temporary, occurs more frequently than is ever read of in the journals. While it may be but temporary, it is annoying during the months it remains. He had been very fortunate himself in this regard, and attributed it to the experience he had gained in teaching the radical and other operations upon the cadaver for so many years. For the past two or three years he did not recall a case, aside from two which came on from pressure of packing and were but temporary. Regarding the anastomosis of the facial and hypoglossal, it had been done, but the procedure was not yet proven to be of much benefit. Regarding skin grafting, the speaker noted that Dr. Dench was still enthusiastic, but that he was one of the few in New York City who had much confidence in it and its results. The speaker has practically abandoned it, and is able to get better results without it than by its use. He thought there were several objections to it, chiefly that it required the patient to submit to a second operation.

Dr. Kaspar Pischel, San Francisco, said that some patients returned thinking that the operation had done no good; but it is well known that it is but the breaking down of the poorly nourished integument. He has devised a flap which will furnish a good skin and will allow the wound to close immediately. (Published in the *Archives of Otology,* Vol. XXX, No. 2, 1901.) The doctor demonstrated his procedure.

Dr. E. B. Dench, closing the discussion, said he had performed a radical operation, found the facial nerve and exposed it for three-quarters of an inch. When it was picked up there was no response to mechanical stimulus. Two years later the patient had perfect control. Provided there is no division, there is no limit as to time when functions may be restored. He thought Dr. Richardson's idea of introducing no packing after the primary packing had been removed, was exceedingly good. He was much interested in the periosteal flap mentioned by Dr. Holmes, and what Dr. Phillips said regarding fatalities was also true. There are a good many cases quite serious when they come under operation. They have chronic suppuration dating back for years and have been suffering perhaps from intracranial infection, prior to operation. He thought that in a certain proportion of these cases a meningitis or brain abscess may be lighted up. On the other

hand, at autopsies, brain abscess cavities are found absolutely sterile. If the slightest infection is introduced a brain abscess may be verified. Out of 95 cases there were only four cases of paralysis. He was also in accord with what Dr. Phillips said regarding skin graft. He also finds it difficult to anesthetize a second time, though if the patient is told it is to be done in two stages, it may be performed. He thought Dr. Pischel's flap a very good one. All these wounds are closed at the time of operation.

XXXII.

OCULAR SYMPTOMS OF NASAL ORIGIN—REPORT OF A CASE OF RETROBULBAR NEURITIS AND OTHER ILLUSTRATIVE CASES.*

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The comparatively recent studies of the accessory sinuses of the nose (notably those of Onodi, Killian, Hajek, Logan Turner, Cryer, Lothrop and Mosher) and the pathologic findings, largely the result of surgical interference in suppuration of these sinuses, have caused widespread interest in this field of surgical work. The accumulation of clinical experience in this region has increased with the rapidly spreading search to discover the seat of suppuration in cases of so-called "nasal catarrh." One result of this searching inquiry into nasal suppuration has been a partial realignment of the recently more or less disassociated specialties of ophthalmology and rhinology, in so far as greater attention is being paid to the causal connection between certain ocular symptoms and suppuration in the adjacent accessory sinuses of the nose. Aside from orbital abscesses that plainly point to the frontal sinus or anterior ethmoidal cells as the primary cause, there are other ocular symptoms resulting from disease of the deeper sinuses, namely, the posterior ethmoidal and sphenoid cells, which often cannot so easily be traced to their true source.

The association of the nervous and vascular supply to the eye and nose is readily seen by such common symptoms as the congestion of the conjunctiva in an ordinary "cold in the head," or conversely, the sneezing that often results from looking at the sun, explained through the nasal reflex from irritation of the ciliary nerves of the eye. Again, the frontal headache, eye-

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ache and tired feeling resulting from use of the eyes during an acute coryza are commonly noted symptoms. That these ocular symptoms result reflexly from disturbances of the circulation in the acutely inflamed accessory sinuses of the nose seems evident from the aggravation of the same symptoms, even to the production of edema of the eyelids and severe pain in the eyes when the nasal trouble is more severe. It is immaterial whether the ocular symptoms result from actual obstruction in the anastomotic circulation between the eye and nose (as in the anterior and posterior ethmoidal vessels); or from a reflex through the fifth nerve to the sympathetic nerves which have vaso-motor control of the circulation of both the eye and the nose. The point that is meant to be emphasized is, that it is a generally accepted fact that certain ocular symptoms arise apparently reflexly from acute inflammation of the accessory sinuses.

If this is true in acute inflamamtion, it is equally true in chronic inflammation of these cavities. Here, as in the acute conditions, we may find orbital abscesses pointing to the associated chronic nasal suppuration when there has been a perforation by necrosis of the orbital wall of some inflamed accessory sinus. But also, as in the acute condition, we may find ocular symptoms other than abscess formation dependent upon chronic suppuration when no perforation has occurred. That these ocular symptoms are often not traced to their true source seems reasonable when it is considered how obscure are many cases of chronic suppuration in the deeper accessory sinuses, and how unlikely is the patient seeking relief from such a symptom as eye-ache to mention a "nasal catarrh" that he has had for years and never expects to be rid of.

Aside from the congestion of the mucous membrane lining these cavities, we have in chronic suppuration an additional cause for the reflex eye symptoms, namely, the overdistension of the sinus with pus. This may result from blocking of the small orifice of the sinus with a polyp or from swelling of the mucous membrane. That the obstruction is often but temporary in these chronic cases and recurs only on acute exacerbation of the inflammation is seen by the recurrence of the ocular symptoms when there is an aggravation of the "nasal catarrh." It is of course well recognized that there are many cases of accessory sinus suppuration in which drainage is

always good and obstruction never occurs sufficiently to cause symptoms. Artificially, as it were, the same symptoms complained of by the patient are sometimes produced by irritation of the accessory sinuses, when from the filling of the cavities with solution sufficient pressure or irritation occur.

The ocular conditions (other than orbital abscesses) most frequently met with that can be traced to nasal trouble may be enumerated as follows:

(1) *Edema of the Eyelids.* Frontal sinus suppuration should be suspected with or without perforation of its orbital wall, especially when the edema is unilateral. Where no perforation exists, the edema may result from obstruction to the venous circulation through inflammatory swelling of the muco-periosteal lining of the sinus. On securing good drainage through the naso-frontal duct in such cases, the edema quickly subsides. In acute cases, as is well known, shrinking of the mucosa of the middle meatus by cocain-adrenalin often opens up the naso-frontal duct, secures good drainage and relieves the symptoms.

(2) *Congestion of the Conjunctiva.* This symptom has been explained above as due either to actual venous obstruction or, and I think more correctly, as a vaso-motor disturbance reflexly produced through the fifth nerve. In this sense it is a nervous symptom and is met with in suppuration in any of the nasal accessory sinuses, as for instance, from the sphenoid alone.

(3) *Ptosis* (often slight). When ptosis is unilateral and is associated with "nasal catarrh," frontal sinus suppuration is to be suspected, on acount of the close anatomic relation of its lower wall to the levator palpebrae superioris muscle. The ptosis, however, is likely due to a paresis of the nerve filament to the muscle rather than due to an actual immobilization of the muscle through direct extension of the frontal sinus suppuration. (Case No. 1.)

(4) *Squint.* This is more likely due to a perforation of the orbital wall of the frontal or anterior ethmoidal cells with a formation of an orbital abscess and involvement of the muscles. In case No. 5, hereinafter reported, the muscular involvement apparently followed perforation of the antrum into the orbit. Posey states (Journal of the A. M. A., July, 1905): "I am of the opinion that if many of the cases of palsy of extra-

ocular muscles attributed to rheumatism were analyzed, an affection of the sinus would be found to be the underlying cause in many instances."

(5) *Pain in the Eye,* varying in intensity from slight eye-ache to very severe deep-seated pains in the eye and head, often unilateral and aggravated on use of the eye, points to disease of any of the accessory sinuses as a possible cause. It may be due to disease of the sphenoid alone (Case No. 2), in which event the pain is often described as "dragging pain in the eye" or "deep behind the eye" and may be accompanied by severe headaches lasting several days. In other cases "an aching and tired feeling in the eye" may be the only complaint. It is possibly true that many patients are refracted for eye-ache without relief because the seat of trouble in the nose was not found and treated. This is not at all improbable when we realize the great difficulty in diagnosis, especially when the sphenoid cavity alone is involved. (Case No. 3 is one in point.)

(6) *Disturbances of Vision* of nasal origin, due to suppuration in the posterior ethmoid cell or sphenoid cavity. The causal relation of disease of these cavities to disturbances of vision was thoroughly worked out by Onodi (Br. Med. Jour., Nov. 5, 1904,) by anatomic demonstrations and a searching review of the cases that have been reported. Onodi and others have shown that the inner wall of the optic canal, frequently formed by the posterior ethmoid cell or sphenoid cavity, is often thin as paper and occasionally shows dehiscences, so that an extension of the inflammation within either cavity to the optic nerve is easily possible. A retrobulbar neuritis may thus occur, resulting in atrophy of a part or all of the optic nerve and corresponding blindness. (Case No. 5 is one in point.) While this is doubtless rare, Onodi has been able to collect numerous cases. Temporary disturbances of vision are said to be more frequent; Posey ("The Ocular Symptoms of Affections of the Accessory Sinuses of the Nose," *Journal A. M. A.,* Sept. 9th '05) states that "edematous infiltration of the nerve is common. Although the change wrought in the nerve is but slight and the symptoms which it excites are not striking, they must be searched for with care."

Aside from these ocular symptoms, which are likely much less rare than is generally believed, numerous ocular conditions are ascribed to nasal sinus suppuration, the causal connection

possibly in some being far fetched. They have not been observed by the writer, nor would they likely be found by those of us who are not engaged in ophthalmologic work. Thus Posey in his instructive paper, referred to above, states that "Zeim, Fromaget, Fish and others have recorded a number of cases of uveitis due to sinusitis, and claim to have seen marked improvement in cases of this nature," also that "Zeim claims that cataracts may be occasioned by diseases of the sinuses"; that Kuhnt has frequently seen "spoke-like opacities of the posterior cortical layer in antral diseases," and that Batten-Fish considers sinusitis to be an "etiological factor in myopia."

Deaths from nasal sinus suppuration are very rare, and therefore opportunity seldom occurs for post-mortem examination of the diseased sinuses of patients who have suffered from associated ocular symptoms. Hence it is necessary all the more to depend on painstaking and often-repeated nasal examinations, if we wish to clear up a certain percentage of obscure ocular symptoms. Furthermore, now that the ophthalmologists have found it necessary to confine their study more and more to the eye, it is incumbent upon those of us who are not doing eye work to keep ourselves and them fully alive to the progress that is being made in this line.

It is hoped that the report of the following cases of chronic suppuration, which with the exception of the case of retrobulbar neuritis are by no means rare, may contribute if only in a small way to the interest in this phase of the subject:

CASE 1.—*Ptosis of the Left Eyelid—Left Frontal, Antrum and Ethmoid Involved.*

Mrs. K—, age 26, was referred Jan. 7, '05, on account of "nasal catarrh" and pain in the left frontal region. She had had nasal discharge for years and a musty odor had been noticed, chiefly by her husband. No other symptoms were remarked until three months ago, when some dull pain and soreness of the left eye and drooping of the left eye-lid appeared. These symptoms had persisted although never severe. She was operated on four years ago, "a bone" being removed from the left side of nose. Otherwise she had had no treatment, except the routine use of a nasal douche. She came to California seven years before and believes some drying up of the nasal discharge followed.

Pus was found on the left side of the nose, in the middle meatus and on the floor. The anterior end of the middle turbinate had been removed and a scab was found adherent to the stump. On wiping this away the middle turbinate was found to be polypoid and pus slowly dripped down from the region of the naso-frontal duct. A cotton-wound applicator passed up rather easily into the frontal sinus, and was followed by a catheter. Some muco-pus was washed out. At a later sitting, the polypoid turbinate was removed and also several clear polyps. Diseased anterior ethmoid cells were removed little by little. Later the antrum was catheterized apparently through the natural opening and muco-pus washed out. The character of the antral secretion was in size and consistency like that of a large pulpy grape with some stringy mucus. A musty odor was apparent, especially on the first irrigation of the antrum and thereafter if the antrum was not irrigated for a week or ten days. There was never any foul-smelling cheesy detritus. After lavage of the cavities, attempts at drying were made by cotton applicators and by having the patient blow the nose with the head inclined to the opposite side. The right side of the nose was apparently not affected. After irrigating the frontal, a marked increase in the ptosis was apparent for a few hours. After four months' treatment, the pain and soreness passed off and the ptosis became barely perceptible. Several months later, the patient was quite comfortable, although she occasionally had a little soreness and a slight drooping of the eyelid, especially when she had a cold. The discharge had not been so bad nor so objectionable as formerly.

CASE 2.—*Dull Pain in the Right Eye—The Right Sphenoid Involved.*

Miss K—, age 21, sought treatment Jan., 1905, for "nasal catarrh," "dragging pain" in the right eye and some congestion of the conjunctiva. (It was an interesting fact that the causal connection between the eye-ache and the nasal trouble was suspected by the patient for the first time on account of a short lecture given to a class of nurses, of which she was a member.)

The patient came to California three months before seeking treatment, largely on acount of the "nasal catarrh." The discharge began six or eight years before, had been constant from in front and behind, but only on the right side. She was quite

sure on this point. It was aggravated by a cold. Never any frontal pain or soreness, but dragging pain deep in the right eye had been more or less constant for three or four years and was worse when she had a cold. Of late it was increased on using her eyes, to such an extent that it was interfering with her studies. She was refracted about four years ago and had worn glasses for awhile without relief. No special nasal treatment had been given.

Examination negative; the nose was clean; there was no sign of sinus suppuration. The patient was advised to consult an oculist and to return if she felt an accumulation of discharge in the nose. A few days later she returned, saying she wished to prove that she was not a case of too active an imagination. Muco-pus was found on the floor of the right side of the nose, far back, and on shrinking the middle turbinate, a streak of muco-pus was seen coming from the region of the sphenoid ostium. There was no pus in the middle meatus and none in the left nasal cavity. The right antrum was punctured and irrigated to exclude that cavity, and to a certain extent to exclude the anterior cells above it. No pus was found. The middle turbinate was subsequently partially removed and the sphenoid ostium could be plainly seen with pus coming from it. Thereafter the ostium was enlarged and the sphenoid cavity regularly irrigated and as thoroughly dried as possible. On March 18 (in two months) the patient stated that the eye-ache had been absent for three weeks, and on June 1st that the eye had remained free of pain or aching even on reading—a relief not experienced for a year. She had not been refracted as requested. The discharge gradually decreased and by July 1st it had ceased. She felt cured. Two months later she again reported that she had remained well, and had done nothing in the way of treatment. She now was free of discharge and had not been sprayed or douched in two months. One month later, after "taking cold," the patient returned very much discouraged on account of the reappearance of the same troublesome symptoms, including the eye-ache, in spite of the fact that she had been refracted and glasses fitted. Several "gobs" of muco-pus were washed out of the sphenoid. The discharge gradually ceased again and the eye-ache and congestion entirely subsided in two or three weeks. On Jan. 5, '06 (about 11 months after the first open-

ing and irrigation of the sphenoid), the patient reported that she had had no discharge and no eye-ache since the last rather evanescent attack from the "cold," and except at this time she had had no treatment in six months. On April 1st, '06, she again reported herself as entirely cured. She was advised to report whenever she had a coryza.

In this case the causal connection between the ocular symptoms and the sphenoid trouble was most noteworthy. Additional evidence was furnished by the reappearance of the symptoms in the right eye on the recurrence of the inflammation of the sinus during a coryza, even after the correction of the eyes. The case demonstrated two other points: 1st—The difficulty of diagnosticating suppuration of the sphenoid alone, which may easily be mistaken for post-nasal catarrh. 2nd—The apparent cure of a chronic sinusitis of many years' duration by means of repeatedly irrigating and drying the cavity—a fact, of course, well corroborated in the experience of others.

CASE 3.—*Eye-ache and Frequent Headaches from Sphenoidal Suppuration.*

Miss M—, age 30, referred Dec. 5th, '05, on account of nasal discharge of five years' duration, chiefly from behind. Used six or eight handkerchiefs a day, and had to leave the table almost every day on account of the post-nasal discharge. Every week or two, had severe aching in the eyes, at first only in the left eye, radiating to the ear, now more in the right eye; described as "deep behind the eye," never over the eye, and almost always ending in a severe headache. These attacks had persisted for ten years, and no relief had been found except the temporary relief from antikamnia, with which she keeps well supplied, and of which she claims to have taken 20 grains per day. She has been refracted six or seven times. She was treated for her nasal catarrh for several years without relief and came to California on account of the trouble. Four years ago, she was operated on by Dr. Bolton of Pasedena, to whom the writer is indebted for referring the case, and since then there had been considerable improvement. At the time of her operation, she was told that her trouble was in the accessory sinuses of the nose. The middle turbinate and much of the ethmoid labyrinth had been removed on both sides and the left sphenoid cavity was opened and repeatedly irrigated. She had lately been advised by Dr. Bolton that he suspected renewed

inflammation and possibly suppuration in the right sphenoid cavity, as the discharge had again increased. He referred the case on account of illness.

On examination it was seen that the inferior and middle turbinates had been partially removed, exposing the anterior surface of the sphenoid. The left ostium was plainly seen, and evidently had been enlarged. The cavity seemed dry. The right sphenoidal ostium could not be seen or felt, some bands of scar-tissue interfering. No pus appeared in the front of the nose on either side. Stringy muco-pus was seen clinging to the posterior naso-pharyngeal wall; its removal caused come gagging. The findings were thus not conclusive of present sinus involvement. Instead, a chronic post-nasal catarrh was regarded as the cause. At a later examination drops of pus appeared in the sphenoid-ethmoid niche on the right side. On removing some bands of scar-tissue in this locality, the sphenoid ostium came into view, and muco-pus was plainly seen coming from this cavity. The ostium was enlarged and the sphenoid regularly irrigated and dried. Still later, a fistula through the sphenoidal septum was found, proven by the introduction and touching together of two probes, one in each sphenoid cavity. Still later the adjacent posterior ethmoid cells were found diseased.

On Jan. 18th patient stated she had marked relief both in the decrease of the discharge and in the absence of eye-ache and headache; that she had gone over a month without headache, other than some headache on the night following the operation to enlarge the ostium—a relief not experienced in years and now had but little discharge and seldom the objectionable gagging attempts at its removal. The patient is still under treatment, April 1st, '06. The discharge has decreased, but not entirely ceased. The headaches, however, have never recurred.

CASE 4.—*Neuralgic Pains in Eyes and Headaches—Chronic Suppuration of Nasal Accessory Sinuses of Both Sides, Associated with Atrophic Rhinitis.*

Miss B—, age 18, treatment sought Sept. 5th, '05, on account of "catarrh." Onset five or six years ago; remembered when the nasal discharge began, but not ascribed to any particular disease; in the beginning had severe pains over the eyes, occurring from time to time and requiring medicine to

give relief. The discharge has been constant, worse on right side, mostly from in front, with some odor, if the nostrils are not daily cleaned out, and worse when she had a "cold." No other symptoms except the dull frontal headaches.

Stringy muco-pus was found on both sides, in the middle and superior meatuses. The turbinates are moderately atrophied; pus is seen coming from the region of the naso-frontal duct on each side after being swabbed off; it reappears on blowing the nose. The nasal surface of the right sphenoid is seen to be covered with thick, red mucous membrane streaked with muco-pus. The ostium could not be seen until the mucous membrane had been well shrunken with cocain-adrenalin, when a dimple was apparent. A probe was introduced into this depression and dropped into the cavity; on its withdrawal a few drops of thick pus at once oozed out, a drop at a time, as fast as mopped away.

Operative treatment was advised and refused. Patient returned two months later, Nov. 6th, with complaint of pains over both eyes, and dull headache for a week. The same conditions were seen as at the previous nasal examination.

The right middle turbinate and much of the ethmoid labyrinth were removed and the ostium of the sphenoid enlarged. The patient is still under treatment (April 1st, '06,) and is much improved, claiming that she uses but one handkerchief a day, against the use of four or five, and that there has been marked relief from the headache.

Case 5.—*Retrobulbar Neuritis, Resulting in Central Scotoma from Suppuration in the Posterior Ethmoidal Cells.*

The extensive involvement of the nasal accessory sinuses confined to one side and the unfortunate result, namely, partial blindness in one eye, and facial deformity, prompts the report of this case in some detail.

C. G., age 46, sought treatment Sept. 12th, '05, in the Ear, Nose and Throat Clinic of the Med. Dept. of the Univ. of Southern California. He had had constant "nasal catarrh" since a boy of 12 or 13 years of age, always from the right side of the nose and accompanied in the beginning by more or less pain in the head and right eye. When about 16 or 17 the trouble "came to a head." The whole right side of the face and head pained severely for many days. He remembered particularly the pain deep in the right eye, which felt as if

the eye was being forced out. The right cheek began to swell and pain as if with the mumps. There was no swelling of or above the eyebrow. The painful swelling of the face was below the eye, but the eyelid puffed out somewhat. After several days of suffering an operation was attempted. He was taken to a Brooklyn hospital and a preliminary operation (tracheotomy) was done, but further operation was abandoned on account of the patient's bad condition. His life was despaired of. The cheek abscess finally broke; marked relief from pain followed; foul-smelling pus escaped for several weeks through the cheek. The fistula finally healed but the cheek bone remains thick, hard and prominent to the present time. The nasal discharge had also persisted, but no more bad symptoms had arisen. He dated and attributed the eye trouble to the abscess inside of the cheek. He remembered that his vision was perfect up to that attack and that he was blind thereafter; that he could not count the fingers of his hand when held before his eye, and that all objects looked hazy. Gradually the eyesight improved somewhat. When he looks directly at an object he cannot distinguish it, but must look a little to one side of it. Also, he remembered that his right eyeball did not move well for a long time after the attack and still is sluggish in its movements.

Examination.—Marked disfigurement of the right side of the face. The malar region of the right side measures transversely 2 cm. more than that of the left. The nasal process of the right superior maxillary bone shares in the thickening. There is a small scar under the lower border of the malar bone, at the site of the fistula; also a scar of the neck from the tracheotomy wound. The alveolar process of the right side shows a prominent ridge from the second bicuspid tooth upward, with the alveolar mucous membrane firmly adherent (he remembers that the abscess also discharged into the mouth in this locality). The right nasal cavity is almost completely blocked up with tough, red polyps covered with crusts and pus. The septum is greatly deflected, almost completely blocking the left side of the nose, which is otherwise apparently normal. Posteriorly, the right choana was fairly well blocked up with a firm red polyp.

On removing several polyps from the right side of the nose, the view of the interior looked as if the septum were entirely

gone, so great is the deflection. The inferior turbinate was seen to be hypertrophied, the upper part of the nose was full of polyps and crusts covered with pus. On removing these the antral wall was seen to be soft and showed several perforations through which pus escaped. The whole of the nasal wall of the right antrum was removed, exposing a large antrum full of polyps and pus. This was easily accomplished without an external operation, due to the septal deflection and the complete absorption of the bony part of the antral wall. In fact, the nasal wall of the antrum consisted of greatly thickened mucous membrane. The antrum was cleaned out and dried. Its walls were covered with thickened muco-periosteum and no necrosed bone could be seen or felt. Later the remains of the middle turbinate and the ethmoid labyrinth were removed. The bony cell walls had also been absorbed, leaving a grumous mass of hypertrophied mucous membrane, polyps and pus, On cleaning this away, the naso-frontal duct was plainly seen, and a large frontal sinus explored. The frontal sinus was empty and its mucous membrane felt smooth and fairly thin. Posteriorly, above and behind the sphenoid a large irregular cavity presented after removal of several polyps, evidently a large posterior ethmoidal cell. This cavity was somewhat larger than the terminal phalanx of the middle finger, extending backwards to a point 9 cm. from the anterior nasal spine, and overlapped the sphenoid cell. It was lined with thin, pale, muco-periosteum. The sphenoid ostium was seen to be about 1.5 cm. above the upper limit of the posterior choana; a probe passed in about 2 cm. into a small, shallow, empty sphenoidal cavity.

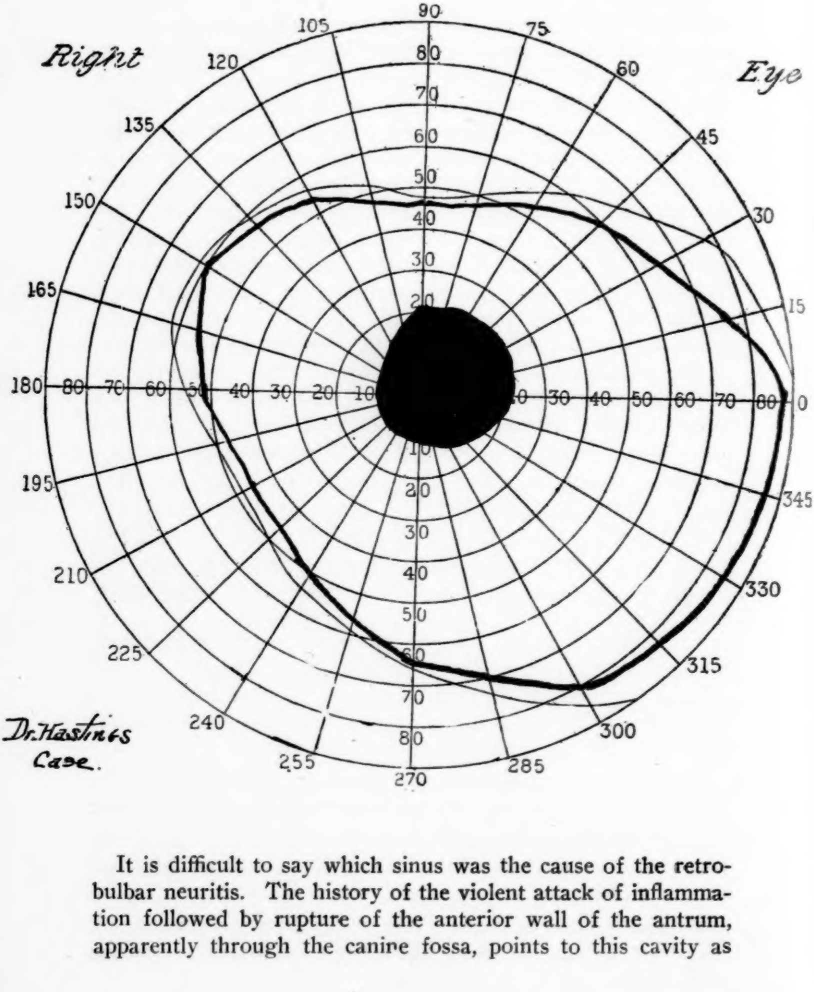
At present, Feb. 1st, '06, the intranasal examination shows that the antrum, large posterior ethmoidal cavity, and the right nasal chamber form one large cavity, into which opens above the naso-frontal duct (6.5 cm. from the anterior nasal spine) and behind the small sphenoidal ostium.

The following measurements of this combined cavity were made by use of graduated probes and are very nearly correct:

(1.) Maxillary Antrum: Height 3 cm., width 3 cm., depth 3 cm. The outer angle of the antrum is 6 cm. from the nasal septum, making an unusually wide nasal cavity.

(2.) Posterior Ethmoid Cell: Height 1.7 cm., width 1.7 cm., depth 2.5 cm. Its posterior wall is 9 cm. from the anterior nasal spine.

(3.) The sphenoid ostium is small, 7.25 cm. from the anterior nasal spine, and a probe can be introduced through it to a depth of 2.25 cm. The cavity seems to be shallow and empty; no pus has been seen coming from it.



It is difficult to say which sinus was the cause of the retrobulbar neuritis. The history of the violent attack of inflammation followed by rupture of the anterior wall of the antrum, apparently through the canine fossa, points to this cavity as

an orbital abscess may have occurred simultaneously. However, the patient states quite positively that the swelling was below the orbit, and that there was no redness or swelling of the eye and no bulging of the eye-ball, all of which would be expected in an orbital abscess of the size indicated by his history. Also, an orbital fistula would have more likely resulted.

The presumptive evidence, therefore, points more strongly to the suppurative inflammation in the ethmoid labyrinth, which must have been most severe. The size and position of the posterior ethmoid cell indicates that in this case it likely enters into the formation of the optic foramen as demonstrated by Onodi. In such cases, Onodi states that the septum between the nerve and the cell is always as "thin as the thinnest paper." Inflammation of the nerve would in this case easily occur during the severely acute attack. In fact, it is difficult to see how the nerve would have escaped being affected.

I am greatly indebted to Dr. W. D. Dilworth, who was interested in the case, for the following report of the eye condition:

Right Eye. Direct central vision, zero. When eye is directed 25 to 30 deg. either above or below, to the right or left, of the type, he has 2-60 vision, which lenses do not improve. External appearance, normal; extrinsic muscles act normally. Reaction of pupil, normal; lens and media are clear; fundus normal, except for atrophy of fibers of the temporal segment of the optic disc. Form field, normal. Absolute central scotoma (see chart), extending from 10 deg. nasal to 22 deg. temporal, and from 20 deg. superiorly to 12 deg. inferiorly. Perception for colors is so poor that color field cannot be recorded. Diagnosis: Retrobulbar atrophy.

Left Eye. Normal, except for refractive error. When corrected vision is 6-6.

XXXIII.

HERPES ZOSTER AURIS.

By Derrick T. Vail, M. D.,

CINCINNATI.

Herpes zoster auris, or herpes zoster auricularis, is, judging from the meager reports found in literature, one of the rarest of diseases. A careful search through the Index Medicus and other sources at my command shows scarcely anything presented to the profession in America on this subject since Green's paper published in the Transactions of the American Otological Society in 1874. Prof. Gruber saw only five cases among twenty thousand aural cases of all kinds. The text books recognize the disease, but few authors mention any cases of their own. Politzer gives a page on the subject; Barr gives four lines; Buck, twelve lines; Roosa does not mention it. Dench gives two pages excellently describing the disease; Burnett gives three and a half pages and explains the disease fully; the American Text-Book of Diseases of the Eye, Ear, Nose and Throat, has three lines by one writer, four lines by another, and two lines by a third on the subject; Posey and Wright on the "Ear, Nose and Throat," give seven lines.

By herpes zoster auris we do not refer to the occurrence of a bleb or two, not uncommonly seen accompanying a severe suppurative inflammation of the deeper structures, but to the idiopathic form which starts as herpes and ends as herpes, presenting pain and the characteristic eruption as prominent symptoms and an uncomplicated picture of herpes.

Case Report.—J. W., age 29, toolmaker by trade, a robust, well-nourished male, enjoying unusually good health, and presenting no striking evidence of a neuropathic predisposition, with a negative family history as regards nervous disorders, a negative personal history as regards the same, consulted me on February 24, 1902.

Present History.—Two days ago he came out of his workshop in an overheated state and stood twenty minutes in a cold wind waiting for a street car. Next morning he noticed

his right ear was stopped up, accompanied by slight twinges of pain in this ear. At 10:30 o'clock the following night, he had sudden severe pain in the ear, and at 1:30 a. m. the pain had increased to an unbearable agony. He dressed himself and walked a few squares to my residence, ringing me up. When I saw him he was holding his hand to his ear and rocking back and forth with pain. I naturally inferred that he was suffering from an acute attack of otitis media.

Examination revealed a normal drum membrane, but on the posterior wall of the auditory canal close to the membrana tympani was seen a large bleb slightly dark in color as if it contained serum and a small amount of blood. The probe test showed that the bleb was raised epithelium and contained fluid. Cocain and adrenalin were used and the blister incised, a painless procedure, evacuating a quantity of blood-stained serum. The pain was not relieved in the least. Further examination revealed an exquisitely sensitive mastoid. Temperature 98; pulse 72. Thinking that there must be some middle ear involvement, the canal was thoroughly sterilized and the membrana tympani incised at the lower posterior attachment to the annulus, a distance of 8 mm. No fluid presented and the canal was carefully plugged, and the patient sent home supplied with four quarter-grain morphin tablets with the instruction to take one and repeat in an hour or two if not relieved.

Next morning, February 25th, the patient's condition was unchanged excepting that he was worn out with pain, which had been unremitting. He had not slept at all—had taken the morphin tablets hourly without relief, the only effect being that they produced drowsiness. Temperature 98; pulse 72. The patient fainted while attempting to walk across the room. The auditory canal was dry, the membrana tympani injected along the line of incision, but no secretion was present. His pain was deep in the ear and over the mastoid. The mastoid region was very tender but not reddened.

Evening of February 25th.—Pain has lasted all day. Prescribed 15 grains trional to take at 10 p. m. and a saline purge ordered. The auditory canal was plugged with cotton, and the ear and side of the head were confined under a large mass of cotton with a roller bandage.

February 26th.—Patient slept some after taking the trional; feels weak and complains continually of deep-seated pain in the ear and in the mastoid region. Has an ashen color and

an anxious expression. Inspection shows a crop of ten vesicles over the tip of the mastoid and just below on the side of the neck, the lowest being the largest. The auditory canal is dry and the bleb on the posterior wall is drying up. The incision in the membrana tympani has healed. The posterior wall of the auditory canal is sensitive to touch, as is also the skin over the mastoid. Ordered salol gr. x, phenacetin gr. v, three hourly.

Evening of February 26th.—Pain less severe. The large blebs over the tip of the mastoid have coalesced and recent smaller ones are seen. Temperature 99.

February 29th.—Permitted to come to town in order to have a photograph taken of the ear. The appearance at that time is as shown in the photograph here presented. Feels weak and nervous, and complains of the pain.

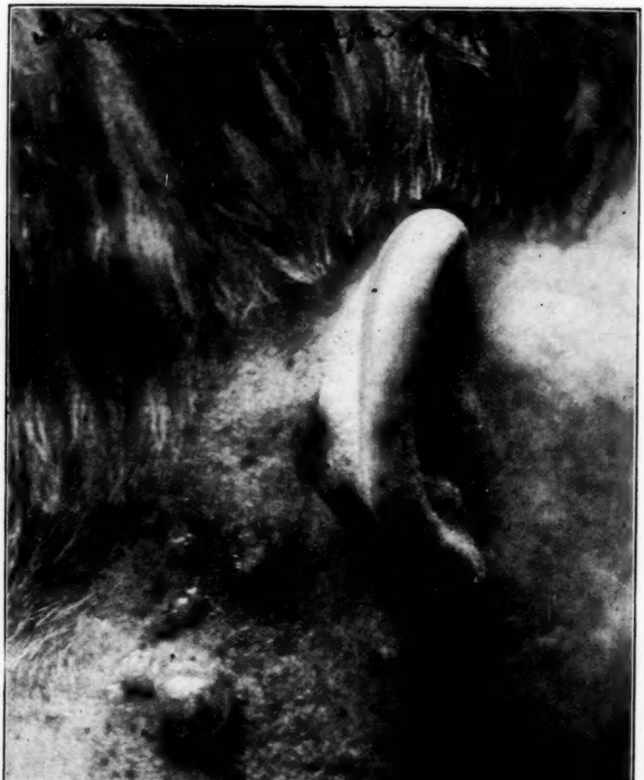
March 1st.—Still has some pain, but is improving. The hearing is improving. The vesicles are smaller and wrinkled; the contents like thickened serum. Air enters the middle ear with a dry sound.

March 8th.—No sloughing. The eruption has dried up and a new scarf skin has formed under the dried eruption. There is paresthesia of the parts, but pain is no longer present. Patient feels well, hearing normal.

Three years later.—No return of symptoms.

An excellent description of the disease is to be found in Burnett's "Treatise on the Ear." He denominates the affection "Idiopathic Herpes Zoster Auricularis," and states that it is a distinct disease of its own class. His description, and, in fact, the description to be found in all sources available to me, mentions the eruption as occurring on the auricle itself, either the front aspect due to involvement of the auriculotemporal, a branch of the trigeminus, or on the posterior surface of the auricle, due to an involvement of the auricularis magnus, a branch of the third cervical.

Gruber has observed herpes of the auditory canal and membrana tympani accompanied by great pain and deafness, and states that he has no doubt that the herpetic eruption occurs in the mucous membrane of the middle ear, basing his supposition on the fact that it has been noticed on other mucous surfaces, notably the soft palate. Hartman, also, has observed the eruption on the membrana tympani.



In Dench's admirable text-book on the ear, we find a good description of the disease. He states that it is extremely rare and is essentially the same as herpes zoster elsewhere. In Politzer's text-book there is published a good lithographic drawing of a case in which the anterior surface of the auricle was involved, and a good description of the disease in question. He states "the situation depends on whether the herpes is caused by an affection of the trigeminus (the anterior surface) or the great auricular (posterior surface) or the ganglion belonging to these nerves." I think he refers to the otic ganglion (or Arnold's ganglion). He mentions pain as the prominent subjective symptom, and the characteristic eruption as the objective one.

Most authors mention fever as a symptom, but Politzer states that it is sometimes present. In my case it was absent.

Politzer and others have observed facial paralysis on the affected side. This would seem to indicate involvement of the otic ganglion, which I believe has a branch of the facial entering it. The facial palsy was only temporary.

There is a type of herpes zoster called "Herpes Zoster Gangrenosus Hystericus." Politzer saw such a case. The eruption was located on the tragus and antitragus, accompanied by excruciating pain and characterized by necrosis of tissue in the area affected, followed by deep ulcers and healing by cicatrization, resulting in deformity.

I wish to call attention to the unusual site of the eruption in my case. Neither the front nor the rear aspect of the auricle was involved, but the eruption occurred on the posterior wall of the auditory canal near the drum membrane and in the region of the mastoid tip. There is no case on record like it that I could find. That it was herpes zoster and nothing else, there is not the slightest doubt, for it ran a typical zoster course. Hay (1) of San Francisco, says, "So typical is the eruption of herpes zoster that among the frequently confusing appearances met with in other diseases of the skin, herpes zoster stands as a definite clinical entity."

Etiology.—I could find no authority among the great pioneers and teachers in otology who would any more than generalize on the etiology.

Dench (2) refers to the neurotic diathesis, dietary indiscretions, faulty assimilation, improper and insufficient food as remote causes, and taking cold and local irritation as exciting ones. Brühl and Politzer mention lymph glandular enlargements in front of and behind the ear. The observation of the lymph glandular enlargement preceding the eruption and, therefore, entering in the etiology of zoster in other regions of the body, was first made by Barthelémy (4) in 1891, and has been corroborated by Baudoin (5), Winfield (6), Howard (7), and others. Strümpell (8) has also verified this observation, and Hay (1) (whose excellent article I freely quote and whose citations I make free to use), states that "there seems no reasonable doubt that adenopathy precedes the eruption."

The work of Grindon (9) is notable, and worthy of mention. He endeavors to separate the secondary zoster from the true idiopathic type, and explains the former as being what he calls "zosteroids." By zosteroids he means any herpetic eruption which accompanies and is caused by a local pathologic state. The following are mentioned: (1) Chronic peripheral irritation; (2) traumatism; (3) pressure on nerve trunks (osteophytes, perineural infiltrations, perineuritis, adhesions); (4) infiltration of a nerve or ganglion from some neoplasm adjacent; (5) irritating substances, such as lactic or uric acid in the blood. The eruptions due to these and other like influcurrent types are nearly always the so-called 'zosteroids.'

Eliminating this group and also other known types, such as arsenical neuritis, etc., we still find a large number of cases that cannot be satisfactorily accounted for other than by assuming the presence of some infectious agent. The following arguments in favor of the infectious theory are advanced by Hay: "(a) The attacks occur more frequently in the spring and autumn months (Weis) (19). (b) It is more common in low altitudes. (c) The course is similar to other infectious exanthematous diseases. (d) True zoster rarely recurs; this seems to argue a certain immunizing influence. (e) The recurrent types are nearly always the so-called 'zosteroids.' (f) Family epidemics are reported (Jamieson) (10). (g) Bacteria have been found in a fatal case affecting the face, observed by Graham (11). (h) The constitutional symptoms are out of proportion to the local neuritis present (Unna) (12)." All these argue a general infection.

Neurasthenia has been credited with causing zoster, but in hysteria, mental worry, etc., Cabot (14) states that the blood count is normal, while in zona, leucocytosis is demonstrable. Hay advances this argument to show that hysteria is not the cause. He does this to clear the way for the infectious theory and thinks that the neurotic manifestations are the result, not the cause of zoster. The "hysterical herpes zoster gangrenosus," Van Harlingen (13) states, is not true zoster, but a simple local gangrene. The eruption on one side of the body with the symptoms of general infection, like general lymphadenitis, seems to strengthen the theory of infection as the cause. Those cases of zoster following an injury may be due to the entrance of the specific infection through the infected part, because Rosenbach and Kast (15) have shown that wounds kept aseptic are not followed by zoster eruptions. The curious fact that only a single nerve tract is involved in zoster, seems at first to be incompatible with the infectious theory, but in arsenical and coal-gas poisoning, there is but a single tract involved, and yet there is in each of these a profound systemic poisoning.

A careful microscopic examination of a lymph gland extracted from a zoster case, under the most rigid aseptic precautions by Hay (1), demonstrated the presence of a large number of micro-organisms, evidently pathologic, but not classified, and many unknown thread-like bodies. This finding argues in favor of the infectious theory.

Osler (17) mentions herpes as occurring in trifacial neuralgia, cerebro-spinal meningitis, febricula, malaria, pneumonia, and typhoid fever; but these are not the idiopathic forms of zoster. Writing of true zoster, he states: "The researches of Head and Campbell make it possible that herpes zoster is an acute specific disease of the nervous system, with localization in the ganglion of the posterior roots." I have been impressed in my observation and study of this disease, that the true types of zoster are essentially ganglionic in origin.

We note in the herpes zoster ophthalmicus, that the affection is probably ganglionic, and in this, my case of herpes zoster auris, there was probably an inflammation, due perhaps to infection in the ganglion that exist on the sensory root of the third cervical or some ganglion supplying nerves to the region affected. If the otic ganglion had been implicated, we would

have had the pinna involved with eruption, associated perhaps with facial paralysis.

Pathology.—Bärensprung (16) first demonstrated an inflammation of the ganglion in the sensory root of the spinal nerve in zoster, and Osler (17) states that there is an acute hemorrhagic inflammation in this ganglion. "There are hemorrhages and inflammatory foci, with destruction of certain of the ganglion cells." On the other hand, Dubler (18) demonstrated a peripheral neuritis with entire absence of central disease, while other observers have found interstitial neuritis and perineuritis.

CONCLUSIONS.

1 Herpes zoster auris is like true zoster elsewhere, a definite disease usually running an acute course.

2 Herpes zoster auris is very rare, but has been observed by a number of noted authorities.

3 It may involve the membrana tympani, as well as deeper parts of the auditory canal.

4 Herpes zoster is most likely an acute infectious disease, causing neuritis, the storm center being in the ganglion of a sensory nerve.

5 Lymphadenitis is almost invariably present and probably precedes the attack.

6 Treatment is of little avail; the disease usually runs a rapid course and heals spontaneously.

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DISCUSSION.

Dr. E. M. Holmes, Boston, recited a case he had 8 or 9 years ago where he was called at night to see a woman 30 years of age with a perfect past history. She had been suffering pain for two hours in her left ear; it was intense and neurotic, coming on in paroxysms. Examination of the ear showed nothing abnormal, and the canal looked normal. The nose and throat were negative. He thought it fight be a reflex from a tooth, but they were perfect and the only explanation along that line would be the so-called pulp stone which could not be diffentiated. The Eustachian tube was catheterized with the head forward. She was given quite an amount of morphin during the night, but she had the pain the following day. Heat and cold was tried without effect. In 36 hours a bleb occurred at the outside portion of the canal, and that afternoon there were several. The pains subsided after a few days and then again occurred. Three months later she had a general herpes extending over several intercostal nerves. This patient, was seen within a year. The doctor was surprised to find a condition so rare beginning in the ear the cause for which he was unable to find. He thought the ganglion theory rather a hard one to prove.

Dr. Wendell C. Phillips, New York, thought that herpes appearing about the ear was perhaps almost as common as the same affection appearing in other parts of the body. It was seen with comparative frequency and he has often observed it in the large clinics over which he presides. So far as his clinical experience went, herpes appearing about the ear was exactly the same as when it appeared in other parts of the body.

Dr. D. T. Vail, in closing, said that since writing the paper he had seen a number of cases of herpetic manifestations about the ear, where deep seated infective processes were at work. He agreed with Dr. Phillips that herpes was frequent in clinics but they all came for some suppurative disease of the ear, and

such cases should be classified as "zosteroids" and not true herpes zoster. The case reported by Dr. Holmes he thought was one analogous to his own. His principal object in writing the paper was to call attention to a neglected chapter in otology.

XXXIV.

SARCOMA OF THE NASOPHARYNX—TREATMENT BY INJECTIONS OF ADRENALIN.*

BY JOHN EDWIN RHODES, M. D.,

CHICAGO.

The prognosis of sarcoma of the nasopharynx is so uniformly bad that any treatment that offers hope for either the amelioration of the symptoms or a possibility of cure deserves our attention. Having recently had an opportunity of trying a remedy in an inoperable and unfavorable case of sarcoma of the rhinopharynx with encouraging results, I wish to present the method employed to the Fellows of the association with the hope that it may be found worthy of further trial in other cases. The treatment employed was first suggested by Mahu, in 1903, and recently used in a case of carcinoma of the rhinopharynx by Berdier and Falabert with very marked benefit.

Mrs. B. G., 22 years of age, married seven months, was sent to me January 19, 1906, by G. E. Turrill of Cleveland, Ohio. Her mother was living and well, and her father had died of erysipelas, following an injury. There was no history of hereditary disease in the family. She had not been well for about twelve years, and for the last three years had been subject to attacks of bronchitis. She had measles in childhood, and had had several attacks of tonsillitis in the preceding three years. She said that she had had a growth removed from the back of her throat five years ago, and that this had been growing for seven years previously. She had complete relief from all the symptoms connected with this growth by the operation, and had no further trouble until seven months ago, about the time of her marriage. The early symptoms were those of a cold in the head, and she had been under treatment since the condition first appeared. About this time she had an attack of what was diagnosticated pertussis, and the growth in the throat which had been in-

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creasing in size slowly before that time, began to grow more rapidly, and continued to enlarge until about two months previous to her visit, since which time it had seemed to remain stationary.

When first seen she complained of a large growth in the back of the throat, completely obstructing the nasal passages, so that no air entered them at all; she also had marked loss of hearing progressively increasing, severe pains, at times, in the back of the neck, radiating to the vertex, a profuse discharge in the nares, which could not be completely removed, because of the obstruction, and also symptoms of dryness of the throat, etc., from the necessity of breathing through the mouth continually. There had been a constant loss of weight, declining from a normal weight of 125 pounds, seven months ago, to 92 at that time. Her appetite was poor, but there had been no fault of digestion and the bowels were regular. The tongue was thickly coated and dry. Her menses had been regular and normal. She said she had become nervous of late. The patient was much emaciated and pale, but her strength was comparatively good, and she was able to come to the office for treatment during the time I had her under observation, although an increasing weakness was evident. She breathed through her mouth, and her voice was the characteristic voice found in complete nasal occlusion. The temperature was 98 F., and the pulse 128, feeble, of small volume, but regular. The heart and lungs were normal.

The nasal cavities were free anteriorly, but the choanae were completely occluded, and the nares were partly filled with thick mucus. The tonsils, uvula, palate, tongue and larynx were normal. A tumor mass presented on the pharyngeal wall, descending to the level of the laryngeal vestibule, and gradually sloping forward and upward behind the velum palati, pressing the latter forward against the posterior molars of the upper jaw. Palpation showed this tumor to be attached on its posterior aspect only, as the finger could be forced between it and the soft palate and choanae, and the Eustachian cushions could be felt by firm pressure. So the tumor had a broad base of attachment on the nasopharyngeal and pharyngeal wall, and undoubtedly originated from the former. It was firm, but not hard, and somewhat lobulated and was pinkish white in color, and on raising the soft palate, its surface

was seen to be mottled with bright red spots. It did not bleed easily, and there were no points of ulceration.

A diagnosis or sarcoma was made, and I sent her to the hospital, and the next day removed a mass of the growth for microscopic examination. This showed a spindle celled sarcoma, highly cellular with many lymphoid cells. Considering everything in the case, especially the certainty of a speedy recurrence of the growth, an operation could not be advised, and at the solicitation of the husband that something be done, I made injections of adrenalin into the substance of the tumor, daily. For this purpose I used a needle long enough to reach the tumor through the nasal cavities. I had the following solution prepared by my druggist:

Adrenalin chlorid ....Gm.	0.12
Acid boric	0.60
Chloretone	0.025
Aqua destillata	15.

Misc.

Ten minims equal five milligrams of adrenalin chlorid.

An injection of five minims of this solution was made into the faucial portion of the growth on January 25th, and a 1-1000 solution of the same was swabbed over the surface. About twenty minutes after the injection she had some nausea, but there was no faintness or any appreciable effect on the pulse. An ulcerated spot had appeared on the anterior surface of the soft palate, due to its being crowded against the left posterior molar by the pressure forward of the tumor, so the injection was made into the portion of the tumor directly behind the ulcerated spot.

On the 27th I injected ten minims of the solution into another place. On the following day I injected the tumor through the right naris, and the next day through the left. In this way I alternated the site of puncture. After the second treatment diminution in the size of the growth was apparent. On the 30th the retraction was shown by the removal of the pressure from the site of the ulcer and the healing of the same. There was an almost complete restoration of hearing from the removal of pressure from the Eustachian tubes, and the pain was very much less.

I made seven injections, when it was thought advisable to send her home and to have the treatment continued there. At

her last two visits the injections caused an almost immediate nausea and vomiting. She had become much weaker at this time, and in her extremely nervous condition on the last day, there followed some faintness with blueness of the lips and weak pulse.

The encouraging results of this treatment were the immediate reduction in size of the sarcomatous mass, and the temporary alleviation of pain. Dr. Turrill continued the treatment after her return home, and wrote me that he had alternated the injection in the nasal cavities and throat with .00025 mg. adrenalin daily, using .005 mg. but once, making seven injections only. The improvement was noticeable, and in about ten days she could blow the left nostril and breathe through the naris at times. Then she had become very weak, with considerable gastric disturbance and vomiting, due she believed to a remedy she was still taking. This was now discontinued. The fauces became inflamed and swollen, but there was no visible increase in the size of the tumor and no necrosis of tissue. A spray of adrenalin relieved the throat symptoms. An attack of diarrhea still further weakened her, but this soon subsided. The treatment was discontinued. The fearful exhaustion due to the inroads of the disease persisted, notwithstanding every effort at nourishment and stimulation, and the patient died March 15th.

While the results were only encouraging in this case, in view of the experience of Mahu by topical application and the notable improvement of the cases treated by Berdier and Falabert, I assume that the method should be given a trial in other instances.

Mahu (*La Presse Medicale,* April 4, 1903) treated three patients with ulcerating epitheliomata by local applications of adrenalin (1-1000) and found it arrested persistent hemorrhage, suppressed the pain, and there followed a rapid and continued amelioration of the general condition of health. He did not claim curative effects, but in each case the neoplasm seemed to have been arrested in growth, for a time at least, and there was less tendency to spread and to invade new tissues. The disease in these cases respectively involved the tongue, the larynx and the laryngeal vestibule. He suggests in conclusion that attempts be made to destroy certain circumscribed epitheliomata by adrenalin injections.

Berdier and Falabert (*La Escuela de Medicina,* Tomo XX,

Num. 24, Dec. 31, 1905) report a series of nine cases of cancer, treated by subcutaneous injections of adrenalin in the internal ones, and interstitial injections in the external ones. The cases are reported at length. The first was one of cancer of the rhinopharynx. The man was fifty-two years of age. He had no specific history and family history was negative. He was well until July, 1902, when he had an attack of erysipelas. In February, 1903, he began to have severe pain in swallowing and intense headache. The nasal passages became occluded. This continued about a month, when an eruption appeared about the nostrils, and there was a foul, sanious discharge from the nose. In June he consulted several specialists, who pronounced his case cancer of the rhinopharynx, and gave a grave prognosis. Later, some portions of the growth were removed. He was finally sent to Dr. Berdier for more radical treatment, in June, 1904. At this time the isthmus of the fauces was very much deformed, the palate very tense, hard, infiltrated, lustrous; the anterior pillar on the right side in a similar condition, extending forward into the buccal cavity, where there was a vegetating mass, irregular in form, covered with a false membrane, gray, adherent, and of a very fetid odor. Posterior rhinoscopy was impossible, but on palpation there was found a hard, irregular mass in the nasopharynx, bleeding easily. The anterior nares were free, save a slight thickening of the mucous membrane. Dysphagia was marked and there was difficulty of respiration. The mucous membranes were pallid. The submaxillary glands were enlarged and hard, and there was enlargement of the axillary and inguinal glands, also. He had had thorough anti-specific treatment over an extended period, without benefit. Topical applications of lactic acid, potassium chlorate, and various other remedies were also tried, but internal remedies were suspended on account of their irritation of the stomach. An application containing cocain 1 to 30 was applied and a gargle of chloral 1 to 200 was used and also enemas of peptones. On June 29th there was some improvement, less odor, he could breathe a little through the nose, pain was less and at greater intervals. The thermo-cautery was used at this time on the oral growths. This improvement was of short duration, and the patient soon became worse. July 10th he applied adrenalin 1-1000 topically to blanch the exuberant masses and reduce the growth. This gave some relief till August 24th

when the condition of the patient was so bad that respiration was labored and stertorous, articulation difficult, as was deglutition also, even of liquids, from increase of the growth and glandular enlargement. Tracheotomy was advised but deferred on recommendation of Falabert, called in consultation, and interstitial injections of one-half milligram of adrenalin begun at irregular intervals of a day or two. In a few days the glands of the neck began to diminish, the patient could open the mouth and began to articulate better, some of the enlarged glands having disappeared after the eighth injection. On September 12th the conditions had changed remarkably. The soft palate had regained its elasticity and motility, the isthmus of the fauces presented an almost normal appearance, the thickness of the mucous membrane had diminished, there was less disturbance in mastication, and the patient could speak more plainly. The axillary and other glands had diminished very noticeably in size. On September 28th a marked gain in weight was noted. In April the weight was 68 kilograms, and this had declined to 46 in September and increased to 56 under the treatment. The patient was reported in good health at the time of the presentation of the paper. It is unfortunate that a histologic examination was not made in this case, but it was seen by a number of the best specialists and they agreed as to the diagnosis. The other cases were cancer of the esophagus; three of cancer of the stomach, one of which was confirmed by a post-mortem; one of epithelioma of the uterine neck; one of epithelioma of the skin, and two of the tongue and mouth. In each of these cases improvement in a marked degree is noted, evidenced by lessening in volume of glands involved, decrease in size of tumors, marked amelioration of pain, increase in weight and general improvement in health.

They conclude that when adrenalin is locally applied or injected it has a great influence on cancerous growths and they advise its use in all cases of cancer, and think it should largely replace morphin as an analgesic.

No satisfactory explanation can yet be given of the physiologic action of the adrenalin in cases of such pathologic change as occurs in cancer and the subject has never been thoroughly studied. Elliott (*Journal of Physiology,* V. 32) has made many and valuable observations of the effects of adrenalin on animals. In his exhaustive treatise, he shows that it accelerates and augments the heart beat, as do the cardiac accelerator

nerves, and that it constricts the blood vessels of the body as do the sympathetic nerves is proven. Constriction is produced in the largest arteries as well as in the arterioles. Another author states that he had found that in the area around the point of the injections the blood vessels were constricted. Vascular dilatation is probably not produced by it, and the veins seem not to be influenced.

On local application to unsound flesh, it blanches it quickly and briefly, being succeeded by venous hyperemia. Its application to plain muscle invariably is followed by contraction, no retraction and relaxation. Melzer and Auer (Trans. Assn. Am. Phys., 1904), in their studies of the effects of injections of adrenalin in delaying the toxic effects of strychnin, concluded that in some way there was an impairment of absorption through the blood vessels by the tissues. They also found that the blood of adrenalin animals clotted more easily. They brought out also another interesting fact, that the suprarenal extract possessed the property of increasing tonicity of contractile tissues, which lasted the longer the less organized this tissue is, showing that the effect is not of short duration. In brief their theory is "It causes an increase in tonicity of the contractile protoplasm of the endothelia of the blood capillaries and lymphatics. This increase in tonicity narrows the lumen of the pores and decreases the facility for the interchange between the blood and the tissue fluid."

It is certain to my mind that in some way the action of the adrenalin is expended largely on the vessels and the blood stream and thus cuts off the nutrition in these growths. At the same time it must have some specific action upon cancerous growths, if we accept the conclusions arrived at by the results in the cases reported by Berdier and Falabert, above referred to. Certain it is, that under an interstitial injection there was an increasing shrinkage of the sarcoma I have reported, and there is no reason to think that this shrinkaye would not have continued if the injections could have been employed longer. The evident increase in physical strength and well being in other cases treated by this method would also tend to show that my patient's rapid decline had nothing to do with the treatment, but continued in spite of it, as is usual in such cases without treatment of any kind.

As this method is new and the action of adrenalin when injected over a long period and frequently is not yet thoroughly

understood, I believe it will be necessary to be cautious in its administration.

Joseph L. Miller has, within the past month; presented at the Congress of American Physicians, at Washington, and admirable study of the production of arterio-sclerosis by the continued administration of adrenalin. In a personal note he has given me briefly his conclusions as follows:

Josue, in 1903, first demonstrated that repeated intravenous injections of adrenalin chlorid would produce in rabbits marked degeneration and calcification of the media of the aorta. It is quite remarkable how rapidly these vascular changes may occur even in as short a time as five or six days or after three to four injections. A few observers have succeeded in producing these same changes by the subcutaneous use of adrenalin and by injecting it into the trachea. The question then arises whether this is a safe remedy when used subcutaneously in man. We know that when given in this way it causes a considerable rise in blood pressure, and this has been considered as an important factor in the arterial changes. Since it has been shown that digalen when administered intravenously to rabbits, may cause arterial changes of similar character, it is probably safe to say that adrenalin is not more dangerous than some other drugs in common use. Of considerable interest is the recent work of Korany, who found that after injecting the animal with iodopin the adrenalin did not produce any change in the vessel.

Elliott found that the daily repetition of small amounts in animals experimented on causes atheroma of the aorta and coronary arteries. The remedy, however, is non-cumulative in action. Would we encounter a like condition in man and should precaution be necessary? The dosage would have everything to do with such a possibility. The experiments by different observers undoubtedly show that calcification of the media of the aorta, and degenerative changes in blood vessels can be produced by injections of adrenalin. It must not be forgotten, however, that the dosage necessary to produce these changes in the animal must be very large, increasing from about three minims to each kilogram of weight in the rabbit. Rabbits of 2000 gm. have been killed in 2½ hours by 20 mg. of pure adrenalin. Smaller doses do not produce atheromatous changes. In human beings it would be necessary to use a proportionate dose—as 180 minims of 1-1000 solution for

one weighing 60 kilograms,—very many times larger than it would be considered safe to use or that would be recommended. There is no doubt, therefore, that the production of an arteriosclerosis in man would be a danger that practically does not exist. A careful histologic examination of the tissues being treated should be made, as it has not yet been demonstrated what the changes in pathologic structures at the site of injection have been.

I unfortunately did not have my patient under observation long enough to permit such examination, but in other cases I trust it will be made. The unpleasant effects of the amount I used may have been due to the rapidity of the injection and possibly the size of the dose. Melzer found the toxic effects of injections of bile much influenced by the rapidity with which they were made and that the rapid injection of a small quantity may have a fatal effect, while a much larger dose could be given slowly without such result. I think this precaution would be well in the use of adrenalin. Death comes speedily in animals from the injections of large quantities of adrenalin, and smaller quantities have provoked glycosuria and inflammatory changes in the liver and kidneys. Symptoms of weakness, prostration, nausea and vomiting may have been evidence that too large a dose was used. I believe 2½ mg. is a safe dose for an injection and possibly 5 mg. is not too large in some cases. The nausea and vomiting, while not severe or prolonged in my case, seemed to be an indication for a smaller dose. I would, therefore, recommend only one milligram every two or three days, as initial dosage for an adult in most cases with a possible cautious increase.

In conclusion, it seems to me, that this method merits trial, especially in carcinomata and sarcomata of the throat and nose, where an unfavorable prognosis must almost without exception be made, and the earlier it can be resorted to the better. I believe it may be safely asserted that it may replace morphin as an analgesic in these cases and that it has a palliative effect, while we have no proof of its being curative in its action as yet. In operable cases, however, where delay would be dangerous, a resort to surgery, as heretofore, should be the rule, until the matter has had further trial.

XXXV.

INFECTIVE SIGMOID SINUS THROMBOSIS—RESECTION OF INTERNAL JUGULAR—REPORT OF CASE—RECOVERY.

By H. Bert. Ellis, M. D.,

LOS ANGELES.

The free communication between the pneumatic spaces covering the lateral sinus and the sinus itself, by the mastoid veins, renders an involvement of the lateral sinus very likely whenever a suppurative process exists in the mastoid; but, as a matter of fact, another very common source of infection is suppuration of the middle ear, the infection reaching the sigmoid sinus by way of the superior petrosal sinus or small venous tributaries, without necessarily a septic process existing in the mastoid.

In brief, infective sigmoid sinus thromboses are ordinarily of otitic origin, and may or may not be secondary to mastoid involvement, however it is through the mastoid we must attack these conditions; not infrequently septic foci are found in the mastoid, though apparently not connected as cause and effect, at the same time as the septic thrombosis.

Infective sigmoid thrombosis occurs more commonly in adults, in males, on the right side and is decidedly more frequent than brain abscess. When an infecting deposit invades the inner lining of a sinus, a fibrous clot forms which may finally occlude the lumen, and pyogenic bacteria develop in the clot, which leads to a general septic infection. The clot may remain localized or extend on down into the internal jugular vein and on to the heart, or pieces of the clot may break off and be carried to other portions of the body and become foci of infection.

The symptoms of this infection are insidious and may not be discovered for some time after the initial involvement.

1. The characteristic symptom, which is most likely first to be noted and possibly the only one, is a sudden rise of the temperature followed by spontaneous and as sudden a drop

of the same to the normal or nearly normal condition; therefore, the temperature should be taken frequently in acute suppuration of the middle ear whether or not there be mastoid involvement. If there be a meningitis or brain abscess besides the sinus thrombosis, this symptom is somewhat disguised, as the temperature seldom drops lower than 101° to 100°. An uncomplicated sinus thrombosis temperature wave frequently amounts to 6° to 8°, and is probably due to the periodic passage into the circulation of broken down portions of the septic clot within the sinus, causing a general infection. If this condition continues for some time a general sepsis develops, with emaciation and an ashy-hued skin.

2. A severe chill is a frequent symptom, but is often entirely absent. Its existence makes the diagnosis the more easy, but its absence in no way excludes sinus thrombosis.

3. Profuse sweating nearly always follows the sudden rise of temperature, but even this may be absent.

4. Headache, mental dullness, paralysis or convulsion when occurring with the other symptoms of sinus thrombosis leads one to suspect and look for a meningitis or brain abscess.

5. A sinus thrombosis which has existed for some time is likely to extend downward into the internal jugular vein. When this does occur there is likely to be some tenderness along the sterno-cleido-mastoid muscle, but personally I have never felt the cord-like ridge which many authors speak of as occurring in this condition.

6. Swelling of the lymphatics behind the ramus of the jaw sometimes takes place in sinus thrombosis, but is of but little diagnostic value, as it may arise from middle or external ear trouble without any involvement of the sinus.

7. The fundus of the eye should always be examined, and if choked disc of opposite eye be found, the sinus, brain or meninges will be likely involved.

8. An unusual and unaccountable depression and weakness is very likely to be found in patients suffering from thrombosis, and its presence may be considered contributory evidence.

It is not necessary here to describe the mastoid operation, but having opened up the mastoid antrum and cells and having removed all infective foci in that region, exposure of the sinus is undertaken. This is sometimes very easy,

especially when there has been much involvement of the mastoid and the sinus groove has been eroded; at other times the difficulty is great, but at all times the greatest care must be exercised in removing the bone, to the end that the sinus be not accidentally opened before you are ready; or that the contained clot be not broken by manipulation. Probably the most satisfactory instrument for this part of the operation is the chisel, as with it you are less likely to wound the sinus wall or disturb the clot. The sinus should be exposed as low down as possible towards the bulb and as high up towards the torcular as may be necessary to expose healthy sinus. If, after having exposed the sinus and having demonstrated that it contains no thrombosis, though the symptoms indicate that it does exist, then it is well to expose the jugular bulb and superior petrosal sinus, for in either of these may lie the trouble.

The appearance, the feel and the pulsation of the sinus have ceased to be large factors in determining the contents of a sinus, because they have so frequently been found to be deceptive. Whenever symptoms of septic sinus thrombosis occur, even though the sinus looks and feels all right, it is our duty to open it. The sinus should be thoroughly opened and when healthy walls are found at both torcular and bulb ends of the opening, pressure plugs may be used and the unhealthy tissue resected, but if thrombosis extends down into the bulb or if the lower portion of thrombosis is undergoing degeneration, then it is decidedly the safer move, for the patient's life, to ligate and resect the internal jugular vein before attempting to remove the thrombus; and when curetting the bulb after a ligation of the jugular it is well to make deep pressure on the opposite internal jugular so as to cut out as far as possible the carrying of small clots or debris into the general circulation by aspiration.

Having curetted the bulb and cleansed the sinus as thoroughly as possible, it is well to carry a piece of gauze into the bulb as far as the postcondylar vein, in order to develop a sudden coagulation and an aseptic thrombus in the bulb, and establish a cross current between the inferior petrosal sinus and the postcondylar vein.

Rapidity of action and gentleness of manipulation are almost as essential for a successful outcome in these cases, as is the operative interference. The mastoid operation, the sinus

operation and the resection of the jugular should be done, if possible, as one operation, at one sitting, and with the utmost despatch, as the danger from shock in this trouble is exceedingly great, and the divided operation is not particularly prone to decrease the mortality rate of this disease.

Report of an operation illustrating this complication: On May 6, 1905, I was called by a confrere in a suburb of Los Angeles to examine with him one of his patients, Miss N.N., a physician's daughter, aged 32. From the patient herself, her sister and the doctor I obtained the following history: When 2 years old she had an attack of acute otitis media with profuse suppuration on the right side. The discharge continued for some time before ceasing, and had recurred several times, during her early life, but she had not had an attack or, in fact, any discharge whatever since coming to California, which had been some five years. On Saturday, April 29, on returning from her work she complained of pain in her right ear and a general headache, which increased in severity as the days passed along. On Sunday the ear began discharging, but the pain in and about the ear continued and was quite severe. She had had some elevation of temperature, but no record had been kept. A nurse was called on May 5th and her records show that between noon of the 5th and noon of the 6th, when I was called in consultation, the patient's temperature varied from 99.2 to 105.2; pulse, 93 to 126; respirations, 18 to 34. Free perspiration after high temperature, dizziness, vomiting, small amount of discharge from the ear. Considerable pain in mastoid region, but only slight tenderness on deep pressure over the antrum. No sagging of postero-superior wall of the canal; the perforation in the drum head was just behind the handle, about the size of a pin head. There was no tenderness along the course of the internal jugular nor was there any lymphatic enlargement. Diagnosis of infective sigmoid sinus thrombosis was made and operation advised as soon as instruments could be obtained and house prepared.

It was thought the danger was too great to have her brought to Los Angeles to a hospital, a distance of some twelve miles. So we utilized the dining room, which the nurse made as aseptic as possible. We operate at 5:30 that afternoon. The mastoid was petrous throughout. The antrum was large and filled with pus and cholesteatomatous mass. Deep in the

substance of the mastoid and extending from the antrum to the sinus groove at the knee, was a strip of softer bone, which was probably the line of infection. The sinus was carefully uncovered (the overlying groove being softened for about 1-3 inch at the knee along the vertical limb), from above this softened tissue to near the jugular bulb. The sinus wall was dark, lusterless and unhealthy in appearance. Palpation gave no definite knowledge. The hypodermic syringe brought away a few drops of stinking, bloody pus; this decided me to ligate the internal jugular vein before disturbing the thrombus. On exposing this vessel, I found a firm clot down the entrance of facial vein, and below that point the vein was only partially filled with blood. I ligated the jugular about one inch above the clavicle, and the facial just above its juncture with the jugular and resected up to clot, and the lower end of the neck wound was temporarily packed. Returning to the sigmoid sinus, I slit it open the full extent of its uncovering and evacuated a very offensive, pussy blood, curetted the sinus as far toward the bulb as possible, and succeeded in getting a fair return flow and introduced gauze to the bulb. The clot in the descending limb of the sinus was then gently removed with the curette and a generous gush of blood washed out all infective material, the hemorrhage was at once checked with gauze plug. As the neck wound had ceased bleeding, and the clot in the jugular vein was firm, the wound was closed and the mastoid wound dressed as usual.

During the next twenty-four hours the temperature never went above 99.2, pulse 97, respiration 24, but about six o'clock p. m. the patient had a slight chill and vomited; temperature went to 102.6. At ten o'clock she had chill lasting fifteen minutes; temperature 103, pulse 131, respiration 31, but after a free movement of the bowels the temperature dropped to 99.6 and the patient had restful sleep. At 6 a. m. on the 8th, the second day after the operation, the mastoid wound was dressed because of the more than ordinary oozing. At noon on the 9th the temperature suddenly went up to 100.6 from normal, and as the patient was complaining of some discomfort in the neck a general dressing was done, the upper portion of the neck wound was inflamed so one stitch was taken out and small amount of pus removed; this probably came from degeneration of the unremoved thrombus.

Thereafter the upper portion of the neck incision was treated as an open wound, and the patient went on in an uneventful way to recovery, and at no time did the temperature exceed 100, the pulse 80 to 90 and respiration 18 to 20.

On the 29th the patient took a long drive, and from that time on went to office for dressings.

After resection of internal jugular for sinus thrombosis, it would seem to me better policy to treat the neck incision as an open wound, no matter how clean the parts may be.

DISCUSSION.

Dr. E. B. Dench, New York, thought it a very interesting case, one which clearly showed what good results could be obtained by prompt intervention. He saw a similar case in which there was only a sudden rise in temperature. The entire drum membrane had been destroyed, and if there ever was a case where good drainage could be obtained that was it; yet on opening up he found a thrombus extending to the jugular. Iodoform packing was introduced to prevent infection from the broken down thrombus. The patient, a woman, was placed upon the table with a temperature of 106, yet the wound healed by primary union. He agrees with Dr. Ellis as to the treatment of neck wounds as open wounds in every instance. Half of the cases he has had have healed by primary union; and if the temperature does rise, he advises removal of the sutures and treating it then as an open wound. In this way more rapid healing can be secured, than if the tissues are allowed to be widely separated. In a fairly clean case it is wise, in the speaker's opinion, to suture. Another point he mentioned was the application of a wet dressing, which gives one a firm union of the cut structures, and the deeper part of the cavity rapidly heals. If it is not aseptic, it would drain from the lower angle.

Dr. E. M. Holmes, Boston, reported the case of a boy who had been operated upon by Dr. Leland a week ago. He had been admitted to the hospital on account of two days' headache. He had a running ear for eleven years. The temperature was normal, but the ear was discharging a small amount of pus. There was no tenderness or enlarged glands to be found anywhere. The only marked thing was a subnormal pulse running about 42 to 50. When the mastoid was

opened, the cells were found to be filled with granulation tissue, and the lateral sinus wall was of a darkish blue color filled with pus. Before opening the sinus the jugular was tied and the upper portion dissected out, but there was still a dark appearance of the inner wall of the sinus. Incision at this point was followed by about a dram of pus. Immediately there was cyanosis and artificial breathing had to be resorted to. The patient recovered and is now on the road to recovery.

Dr. E. W. Day, Pittsburg, was very much interested on account of the temperature. Last November he had a case come into the hospital, a boy, who had chronic discharge for years, with intense headaches. He came from school and that night his temperature was 102; he had a chill and went into semi-coma. On his arrival at the hospital, his temperature was 94.6. At no time did his temperature rise above 95.4; the pulse was between 56 and 60. On opening the mastoid, the cerebellum and the sinus were exposed. The sinus was absolutely gone, and at the point of the sigmoid sinus location, no trace of it could be found, but there was much pus and debris. The lateral sinus was thrombosed. The collapsed vein was found and the surface of the dura over the cerebellum, the walls of the lateral sinus and the superior surface of the cerebellum were found necrosed. The patient never recovered consciousness and died with a temperature and pulse entirely subnormal.

Dr. H. L. Myers, Norfolk, stated that his experience in cases of resection of the jugular in sigmoid sinus cases had not been large; in fact, he had done the operation only three times. One of these cases had come into the hospital presenting a marked swelling over the right mastoid region and the ear was discharging freely. Twenty-four hours after admission the mastoid was opened and found in very bad condition; despite this fact, the temperature was normal at the time of the operation as it had been previously when we could examine it.

The ordinary mastoid operation was performed. On the third day the temperature rose, and from the septic look of the child and other signs such as great depression, he determined to explore the sinus. The operation disclosed a badly thrombosed sinus, and after establishing the flow from above and failing to establish it from below, the jugular

was resected from as high a point as possible to near the clavicle, a cigarette drain was introduced and the neck closed. Three days later the temperature took a jump to 103° F., and on opening the dressing I found the neck wound full of pus and the drain doing little service, the sutures were removed, the wound cleansed and treated openly and the patient had a rapid recovery. In every one of the three cases coming under my observation, the neck wound was closed and had to be treated as an open wound afterwards on account of infection, despite the best surgical technic I was capable of. After this experience, I confess I began to feel that it is of little use to close the neck wound at the time of the resection.

Dr. B. E. Fryer, Kansas City, asked if in these cases of subnormal temperature any blood count had been made. He would suggest that a leucocytosis in these cases would be diagnostic. Where there is subnormal temperature, with sepsis involving the jugular, as a rule oscillating temperature prevails, but where it remains down a hypoleucocytosis is an indication of the want of reactive power.

Dr. E. M. Fleming, Los Angeles, reported a case of 100 days' duration. The man came with an acute otitis media, and was relieved after incision of the drumhead. At the end of four weeks, the discharge still profusely present, it was suggested that he would probably not recover unless mastoid operation was performed. There were no symptoms of mastoiditis, and it was suggested simply on account of the persistent and profuse discharge. Operation was refused on the ground that he was a diabetic. During the next thirty days he received office treatment and there was no high temperature. One month after having advised operation he was suddenly seized with two slight convulsions and apparently recovered with ill effects, but still refused operation. Thirty days later he had another seizure, with complete aphasia and a semi-unconsciousness; the operation was again strongly suggested. He was taken to the table and fluid pus was evacuated and the presence of a temporo-sphenoidal brain abscess made out and in Broca's area a large quantity of fluid was found. After the operation the patient died. This condition may exist without typical symptoms.

Dr. E. B Dench, New York, desired to place on record a case of pronounced general chorea in which operation was delayed, although there was suppuration. Choreic convulsions were so violent that the anesthetic was with much difficulty administered. The dura was exposed over the middle cranial fossa, but it was found to be normal. The chorea disappeared after the operation and has not since returned.

Dr. C. W. Richardson, Washington, said that the diagnosis of thrombosis was not always easy, and at times there was considerable doubt. During the past winter he had two cases which would illustrate this difficulty markedly One was a child 9 years of age who was unconscious and in the throes of violent convulsions, with a temperature of 105. The urine had been examined and sugar and casts were found. The physician in attendance called in the speaker simply because the child had had chronic suppuration from the ear. It was at once taken to the hospital and operated upon. An extradural abscess was found with no involvement of the sinus. The most remarkable thing about the case was that the urine ran between 90 and 132 ounces per diem for nearly a week. Another case was the child of a neighboring physician about 2 years of age that had been running a temperature three or four days, for which there was no apparent cause. The speaker was called early on the fourth day because the child continually had its hand on the right side of its head. The child was watched for five days, during which time it ran a temperature from 99 to 104 or 105 every day. There was free drainage and no bulging and no tenderness over the mastoid. Blood counts made on the third and fifth days showed no leucocytosis. On the seventh day the mastoid was explored and a typical osteomyelitis was found. The sinus was free, firm and normal. These two cases both suggested involvement of the sinus, yet in neither case was it affected.

Dr. Joseph Beck, Chicago, related two interesting points in a typical case of sinus thrombosis, where it had extended almost two-thirds down the neck and jugular, and where an exposure for the usual radical proceedure for mastoid was done. On the following morning the temperature was 99; it had been 104 before the operation. Three days later the patient had a chill followed by pain in the right side of the

chest, high temperature and a rusty sputum lasting three days. Three days later the condition was repeated on the opposite side, also clearing up after three days. Pneumococci was present in the sputum. He had repeated chills during five weeks with fever and the usual course of a septicemia. Good results were obtained by the hypodermic injection of glycogen in these cases.

Dr. E. W. Day, Pittsburg, showed a few temperature charts from cases of mistaken diagnosis. The first chart was a case of a boy 5 years old who had had measles with a middle ear suppuration. The measles cleared up, but the ear continued to discharge, and he complained of pain in the mastoid. The temperature ran from 90 to 104 and 106 with chill and a good fall to 99, then up to 105 and then below 100 and up and down. The doctor expressed some doubt that it might be sinus thrombosis. An expert was sent for and the child examined and he diagnosticated pneumonia. Nothing was done to the mastoid, the pneumonia cleared up and the patient recovered.

The next chart was in a case of measles; the child had apparently been healthy for two months prior to the time spoken of. Each afternoon the little girl would say she felt tired and wished to be held. Suddenly, one Sunday night she complained of pain in the ear with profuse purulent discharge. She immediately began to run a temperature of 102, falling to 99 and rising in the afternoon to 103 and zigzagging, until, ten days later, when the glands along the neck became swollen and tender over the mastoid. The case was examined by four other physicians and no complication could be detected. As it was the doctor's own child he could not bring himself to the point of having it operated upon. Five days later the opposite glands and the inguinal glands became swollen. The blood count showed 23,000 leucocytes, the polymorpho-nuclear cells were 63% and the hemaglobin 50%. Dr. Litchfield thought it a case of malnutrition and that the ear was simply a manifestation of that condition. Operation was not performed and the child recovered.

The next chart is of a little patient seen the latter part of March. He had measles with ear trouble. A month later the mastoid was bulging and the patient was operated upon, but instead of getting better it grew worse. The other mas-

toid was opened, but still it remained in a bad condition. Pus was found in both mastoids. The chest was thoroughly gone over. The blood count showed 63% polymorpho-nuclear cells and the leucocytosis was 27000. Sinus thrombosis was then suspected, both sinuses were opened and both were absolutely normal; the temperature then began to zigzag. Typhoid tests were made, but they proved negative. At the post-mortem the veins of the brain were found to be slightly congested. When the sinus was opened a probe was passed and a free return of blood was obtained; but in the right sinus a non-adherent clot was found, having its origin and fastened to the point that was cut. In the lungs, lying between the pleura and pericardium, a pus sac was found the size of a hen's egg. The right lung at the upper portion showed an old pneumonia, and below it a recent pneumonia and in the left lung a still more recent pneumonia. The doctor thought that in many of these cases in children, the fact was overlooked that a great many other conditions gave rise to the symptoms simulating thrombosis of the sinus. He believed that very often in children and babies a condition is present that was referable to the respiratory tract and which cannot be diagnosed, and too much pressure is brought to bear on the sinus thrombosis theory and the other conditions overlooked.

Dr. J. A. Stucky, Lexington, said that Dr. Day had brought out the point he had tried to emphasize at Buffalo last June: that the symptoms caused by intestinal toxemia simulated those of sinus thrombosis as far as temperature showed. He has never opened the lateral sinus. The septic condition of the mastoid present, plus the condition produced by the anesthetic, so weakened the intestinal canal that the toxines are absorbed and the symptoms of sinus thrombosis are made manifest. Two or three doses of castor oil and a colon tube, he thought, performed wonders.

Dr. Wendell C. Phillips, New York, wished to protest at the unwarranted operative interference in suspected cases where the diagnosis was based upon high temperature only. Young children previous to rupture of drum or paracentesis were extremely prone to high temperature, which usually subsided promptly a few hours after a free opening in the drum had been made. These cases also usually had a high polymorpho-nuclear percentage.

Dr. E. M. Holmes, Boston, said regarding the blood count, one case showed 11000 white and the next day there would be but 9000 and on the third day after operation 14000. It was not always absolute.

Dr. J. F. Barnhill, Indianapolis, thought there was a possibility that Dr. Day's case had a lateral sinus thrombosis which was taken care of by the child's own system.

Dr. E. B. Dench, New York, said there were some cases that did well without operation. He had found in one case the lateral sinus absolutely obliterated, yet the patient recovered. He had a case, a child, 18 months old, for whom he was consulted, who had an unexplained temperature. He performed double paracentesis, and after seven days the temperature rose to 107°. Two careful diagnosticians went over the chest, but said they found nothing. The leucocyte count was 27000 and the polymorpho-nuclear 87%. The next day the temperature went down to 99 and the child gradually recovered. Another child of 18 months had run an irregular high temperature for five days. For the first three days there were no ear symptoms. Incision; staphylococcus infection present; no drainage. Three myringotomies were performed. There was no tenderness over the mastoid, but there was swelling of the canal. Everything else was excluded. The blood count had been made and a high leucocytosis was evidenced, so pneumonia was sought after. The day following the polymorpho-nuclear were down to 29%. The mastoid was opened and was found to be filled with pus, yet the bony wall was firm. Forty-eight hours later the sinus was opened and a clot found extending from the knee seven-eighths of an inch to the torcular Herophili. The wound was packed and the temperature began to fall. Sixty hours after the operation, at the first dressing, there was a slight amount of pus, of which the speaker was afraid. That night the temperature again rose to 107, but the following morning at 7 it was down to 99, and the jugular vein was incised from the innominate to the base of the skull. It was like a pipe stem. The child died ten days later of sepsis.

XXXVI.

THREE FATAL CASES OF MENINGITIS WITH PECULIAR EAR SYMPTOMS.*

By Dr. W. H. Roberts,

PASADENA, CAL.

These cases with their post-mortem findings are reported in the hopes that what is learned may be of benefit to us all, and particularly that from the last two we may learn to look earlier for symptoms of meningeal involvement.

The first is chiefly of interest because the autopsy so clearly confirmed the diagnosis made over a month before death, and because of the remarkable condition found in the middle ear.

The last two, I think, teach among other things, that we should never examine an ear with an acute otitis media without keeping ever before us the possibility of a meningitis developing in spite of the proper treatment being instituted. We should therefore always be guarded in our prognosis in all acute middle ear inflammations.

Case 1.—On January 20, 1905, W. H., age 50, came under my care bearing the following letter from his physician in the country:

"Dear Doctor:—The bearer came to me about two months ago with neuralgic pains in and about the left ear and brow, and in a general run-down condition, which I attributed chiefly to a very septic condition of the mouth. He has had the pains off and on since that time, has continued weak and hardly gains at all. About a week or ten days ago, swelling, slight redness and tenderness on pressure over the mastoid tip came on. There has, at no time, been any discharge from the ear. Evening temperature has been slightly raised for some time and pulse about 100. Deafness was about complete when he came to me, although he says he had quite recently received telephone

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messages with that ear. Watch tick audible about eight inches on the other side, but today it is almost deaf to watch tick. I blistered over mastoid twice when he first came to me."

On examination I found the entire mastoid tender, considerable edema of the tip and neck, drum dull, thickened, but not in the least congested. No evidence of perforation, no sagging of the canal, very marked degree of deafness. Temperature 99.8.

Diagnosis: Mastoiditis with Bezold perforation of the tip.

I advised patient to go immediately to the hospital and expected to operate that evening. The patient consented, but expressed a wish to return home for an hour or two in order to attend to some necessary business before going to the hospital. Nothing more was seen of him until the morning of the 24th of February, when a telephone message was received from his home in the country, saying that he was in a very bad condition—dying, it was feared.

On my arrival there I learned that the man had been losing ground steadily for some weeks, although complaining less and less of pain around his ear until within the last two or three days, when he remained in bed most of the time with hot applications to the ear. The morning before, he complained of very severe pain in the small of his back, which he had injured some years before by being thrown out of a buggy. Toward evening he became rather irrational, with a slow pulse in the neighborhood of 60.

All night he was exceedingly restless and on the morning of the 24th he could only be aroused with difficulty. I found skin cold and clammy, patient groaning, throwing himself from side to side in the bed, and at times holding his hand to his forehead and left ear. Pressure over the mastoid made him wince, and on asking if it hurt he replied "Yes," the only intelligent answer obtained. There were no facilities in the house for making a satisfactory examination, but because of the slow pulse I thought there was the possibility of brain abscess, and as the sons wished to take the chances of an operation, I had the patient taken to the hospital in an ambulance, where I saw him at five o'clock, with Dr. Hill Hastings, of Los Angeles. Temperature 102 deg., pulse 100. The entire condition had changed, patient then showing signs of active meningitis. Lumbar puncture obtained turbid serum which contained the

pneumococcus. I refused to operate and put an ice pack to his head. Patient died at five o'clock the morning of the 25th.

Autopsy was performed that evening by Dr. Stanley P. Black and myself. Found a diffuse purulent leptomeningitis, most intense at the base of the brain. No signs of abscess. The dura was exceedingly adherent over the left temporal bone, particularly over the petrous portion, and a perforation existed over the roof of the mastoid antrum. The bone was very congested over the antrum and middle ear and much softened. On opening the antrum I found it filled with pus, as were all the mastoid cells, which had practically broken down, forming one large cavity. The probe passed readily through the perforation at the tip of the mastoid and three inches into the neck. After removing the softened superior wall of the attic the middle ear was found entirely normal and dry, mucous membrane not adherent, stripping readily from the bony walls, and the ossicles in good condition.

This man's life was sacrificed by his obstinate determination not to go to the hospital, or to submit to an operation. After his return home his physician and his sons tried to persuade him to follow my advice, but without avail.

CASE 2.—Miss L. H., age 25; occupation, dressmaker. I first saw her at 9 p. m., August 7, 1903, by request of Dr. A. T. Newcomb, and the following history was obtained:

For over a year had had spells of dizziness, worse particularly the past month. One month prior to this she had fainted. For four weeks she had had a great deal of pain in her back and had been under a physician's care for sciatic rheumatism. During the latter part of this time she had been running some temperature. On the morning of August 1st she had shampooed her hair and that day some tonsillitis set in. On the fifth she called at Dr. Newcomb's office for treatment for her tonsils. That morning she had some neuralgic pains in her right ear. In the evening the pains became very severe in the ear and over that side of her head. By ten o'clock the pains had begun to quiet and the following morning the ear began to discharge some straw-colored serum. From that time on she had no more pain in her ear.

I was called by Dr. Newcomb to see the patient because of some mastoid tenderness. Examination revealed the following:

The patient was excessively nervous. The muscles of the

right side of the neck were quite tender, but very slight mastoid tenderness. The external auditory canal contained some whitish flakes which were removed by syringing. The drum was exceedingly congested and thickened so that I was unable to make out the landmarks. The middle ear was full of straw-colored serum (no pus), which was removed by Politzer inflation and pneumatic speculum. This improved her hearing and made her feel more comfortable. The patient also complained of very severe pain in the back of her neck, in the cervical region, and severe frontal headache. The pupils were normal. The ear was dressed with a cotton wick containing glycerine and carbolic acid. On the following morning I learned that the patient did not sleep until about 3 a. m. She had no pain in the ear since the treatment. The cotton pad outside the wick was wet with straw-colored serum, no secretion in the canal and none came from the middle ear by Politzer inflation, or pneumatic speculum. She was complaining of intense pain in the cervical and lumber regions and also the frontal region of her head. She had some abdominal tenderness. Temperature 102.6, pulse 96, pupils normal. The patient looked very sick and was removed to the hospital for better treatment than she could receive at her home. At 2:30 that afternoon at the hospital, she seemed to be in a condition of collapse. Her features were drawn, pulse weak, temperature 103.8 (rectal). I found a slight amount of pus in the canal, from which no culture was made as the swab was lost. Shrapnell's membrane red. I performed paracentesis under chloroform, but got only blood. Under the chloroform her pulse became very weak, and it was necessary to give strychnin injections (hypodermic) and oxygen inhalations with normal salt under the breasts. She had a peculiar eruption over the abdomen and complained of intense pain in the back of the neck, lumbar and frontal regions. Symptoms now all pointed to meningitis. On the morning of the 9th, a lumbar puncture was made, showing almost pure culture of the pneumococcus, leucocytosis of 35000. In the afternon her right pupil became dilated. Death occurred at 7:30 p. m. Patient retained consciousness almost to the last.

Autopsy.—On removing the skull cap, the right hemisphere was found bathed in pus, which had traveled down the right optic nerve. On inspection, the right petrous portion of the

temporal bone appeared to be normal, but on a slight tapping with the chisel the whole bone caved in, being entirely necrotic, filled with pus and granulation tissue. The mastoid was not opened, the autopsy being performed by a novice, who, in his carelessness, destroyed the petrous portion of the temporal bone, thus losing much valuable information. This patient had had no pain in her right ear until four days before her death. If the temporal bone had become infected on the day the pain in the ear began, was there time enough for the petrous portion to become entirely necrotic? Was there not rather primary osteomyelitis here with secondary involvement of the middle ear?

Case 3 is reported in detail, as it presents some very interesting symptoms, which in a great measure deceived the physicians who were called in on the case.

I was called on the morning of January 11th, 1905, to see F. M., age 15, who was suffering from acute pain in the left ear, which had started about 2 o'clock that morning, lasting until 5, when the ear began to discharge some serum.

When examining at 8 o'clock, I found intense congestion of the drum, with bulging, a small pin point perforation at the middle of the drum, which seemed to be blocked with secretion. Under chloroform anethesia, the left drum was opened freely evacuating large quantities of bloody serum. The patient at once went to sleep and slept the rest of the day in perfect comfort, the ear discharging well.

The following ear history was obtained: He had had frequent attacks of earache, the last attack being about Thanksgiving, when his right ear ached for some little time and then discharged pus for a few days. At this time his ear was treated by syringing, but was not under the care of any specialist.

Before incising the left drum, the right was examined and some congestion of Shrapnell's membrane found. Also a slight ring of congestion extending nearly the entire circumference of the drum. He had no pain whatever in this ear, but his mother was advised to apply a hot water bag to it, which she forgot to do, as he was so comfortable. At 5 p. m. the boy's temperature was 103.3, pulse 116. Right drum not as much congested as in the morning. The left ear was discharging freely and was perfectly comfortable.

On calling the next morning, I found that during the night the right drum had ruptured without any pain or warning, discharging yellowish pus with some odor. The left was comfortable and draining nicely. Temperature 100. The patient was given calomel purging, and bichlorid douching for each ear. At 6 p. m. I learned that his temperature had been high all day, reaching 104 several times. He was free from pain, both ears discharging copiously with slight tenderness of mastoid on the right side. January 13th, temperature at 8 a. m. 101, ears discharged freely during the night, but both throbbed with sensation of dull pain that morning. I syringed ears with biclorid solution, getting away considerable secretion, with relief from pain and throbbing. Temperature reached 104, pulse in the neighborhood of 100. January 14th, his temperature kept high all day, but his ears were comfortable and discharged freely. Politzer inflation was used with good results. From this time on his ear symptoms gradually improved, the discharge grew less daily and ceased by the 25th.

On the 14th a consultation was held with Doctors King, Black, and Sherk, to discover, if possible, the cause of the high temperature, but nothing was found. The boy felt perfectly well, his only complaint being that we did not allow him enough to eat, and he continually expressed a desire for beefsteak. He was unable to sleep much after the first day of his illness. January 15th he seemed to be better, but his temperature ranged from 102.5 at 6 a. m. to 104 by axilla at 4 p. m., and at 8 p. m. was 102. January 16th, aside from his temperature, he was much better. The range was from 101.3 to 103.4. January 17th, highest temperature was 103.2, lowest 101.8. On the morning of the 18th his temperature was 100.8, but by 4 p. m. had reached 103.6.

Dr. J. M. McBride saw him in consultation, but could not account for the fever, and gave a very hopeful prognosis.

January 19th, his temperature reached 104.5 at noon, and a bath brought it down to 101.8, but it immediately began to go up, and at 8 p. m. was 104.6. At this time Dr. Hill Hastings was called in consultation to see if he thought there could be any ear complication to account for the temperature. He found the ears in good condition and apparently not accountable for the febrile condition. He, however, found some fibrillary twitching of the fibers of the pectorals major mus-

cles on drawing the fingernail quickly across the muscle; there was also a marked Koernig. The pupils were even and active, and there were no mental disturbances of any kind. He made a diagnosis of meningitis, not of otitic origin, but probably due to an influenza infection. His prognosis was unfavorable.

Those of us who had been seeing the boy could not bring ourselves to agree fully with him in spite of the evidences of meningeal irritation. We were inclined to view these meningeal symptoms as a result of the febrile condition and not the cause. On the 20th he was about the same. Frequent baths kept the temperature under 103.5 most of the time. January 21st he was not so well. Dr. Sherk did a lumbar puncture, but failed to get fluid. His temperature reached 105, and then, on Dr. McBride's advice, small doses of acetanilid were used, and his temperature stayed at 104. His pulse all this time was about 100.

January 22d. On the morning of this day he complained first of some lumbar pain, due to the puncture of the day before. At noon there was noticed occasional twitching of the body, and that afternoon he spoke of pain in the back of his head. That night he also complained of headache.

January 23d. Early in the morning he had a nosebleed. Later he refused nourishment. He could not sleep, but was not in any pain. Later in the morning he spoke of pain first in the top of the head, then, in a few hours, all over head, and also in the lumbar region. Symptoms of meningitis were becoming more prominent, but his pupils were normal and he kept pretty rational. That afternoon he awakened from a sleep in a sort of a night terror, and it took some time to quiet him.

On the morning of January 24th there was frequent jerking of the legs and constant fumbling with the hands. He had a comfortable night, was free from pain, complained some of his back when he moved and was quite irritable when disturbed. That evening there was pain in his back, extending downward from waist line, and turning caused pain in his neck. Later that night he became irrational at intervals.

January 25th I reopened both drums under chloroform, with negative results. That evening there was some serous discharge from the left ear. He gradually became more restless, would pick at bed clothes and mutter when asleep, and became more and more irritable when awake.

January 26th, his neck was stiff and would hurt him on turning. There was a profuse serous discharge from the left ear in the morning.

January 27th, he was rational when awake, but very restless when asleep. Once in the afternoon there was considerable serous discharge from his left ear, but from this time on it was very scanty.

January 28th, he was restless during the morning. At 2 p. m. he said he was very thirsty. He sat up to take a drink of water, and after drinking said, "Why, I can't see," and fell back on his pillow unconscious. Active delirium then set in, his abodmen became distended, he voided urine involuntarily, and at 2:10 on the morning of January 29th he died.

Autopsy that afternoon by Dr. Stanley P. Black and myself revealed a rather diffuse leptomeningitis, most marked at the base. There was no apparent meningitis in either temporal region. There was no necrosis of either temporal bone. Both mastoids were normal. The left middle ear contained a slight amount of serum. There were no evidences whatever found to lead us to think that the meningitis was of otitic origin. Cultures taken from the cerebro-spinal fluid showed the streptococcus.

XXXVII.

THE NASAL TURBINATE AS A VASO-MOTOR INDEX.

By James A. Babbitt, M. D.,

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The responsibility for physical examination in adolescence, whether general or of special senses, affords much difficulty in the determination of reliable basis for judgment. On purely morophologic lines, such standards may be readily found, and questions of defects in symmetry and posture are easily settled. Again, examination of heart, lungs and gross abdominal organs as to functional and organic integrity is comparatively simple, and in the special senses as well, gross organic defects of eye, ear, nose and throat are quickly recognized and recorded.

Aside, however, from the mere basis of cautionary advice and records of statistical and anthropometric value, many questions of vast, underlying importance rest in the examiner's estimate of the individual before him. In view of the wide variation even in the normal type, this becomes particularly difficult. The vital question at once arises as to what really constitutes a true type of bodily health. What factors add to best results, and favor general bodily metabolism; what influences lead to most natural and favorable vaso-motor action? Is this individual, and are these special senses, more or less widely differing in formation, nervous reaction, and physiologic activity, in a strictly healthy condition? If doubtful, which is cause and which effect, and where shall the foundation deficiency be located.

Laying aside the general physical problem and confining ourselves to the physical examination of certain special senses, the topic of the paper presents a field of much interest. The term catarrh, in common consideration, is inseparably connected with the nose, throat and ear, though perhaps wrongly so. Yet in spite of this limitation, it presents a wide field of correlated influence, both in its relation to the general lithemic and uric acid problem, and also involving as it does a most

typical erectile surface, and performing its function as a body representative of vaso-motor change in its relation to this general system. It is the importance of this phase in general examination of the special senses, and its significance in the general bodily economy, which seem to warrant its choice for study.

Consider it, too, if you will, in its significance as to the physical condition of the growing child. First, it will be generally conceded that the catarrhal condition wherever found is a most important factor in its influence upon metabolism; secondly, the nasal mucous membrane, particularly the turbinates, are quickly affected by all special sense catarrhs. Let us consider how far, then, their condition is indicative of vital condition.

The vaso-motor system, as its name implies, includes that vast ramification of constrictor and dilator nerve fibers distributed to the muscular coats of the vessel walls, which from direct and reflex impulses practically control the action of all vital processes. Retarded blood supply practically inhibits vital activity; excessive supply produces congestion with similar retrograde results.

Starting from the vaso-motor center in the bulb, with subsidiary centers in the cord, passing out through the sympathetic system, and closely ramifying with the branches of the pneumogastric, this system of vascular nerves is practically the system in control of organic life. Furthermore, stimulation in this tract, of more than functional significance, directly produces pathologic result, evidenced by the gangrene of permanent constriction and degeneration of epithelial surfaces, following permanent dilatation.

As the functional activity of the vaso-motor system is practically limited to the arteries and capillaries, its changes are freely exhibited, and the lightning-like rapidity by which the weight of the body is changed in each consecutive moment shows its potent force. Pallor and blushing of the skin, change in surface temperature, modification in volume, rhythm and pressure of surface pulse, sensory phenomena in great variety, are all vaso-motor in result if not in origin.

Granting then, this vast underlying physiologic system, intangible and undemonstrable in accurate measure, yet perfectly in control of all organic life, it is then but fair to give this ele-

ment a crowning place in the controlling mechanism of the special sense organs, which though possessing individual sensory apparatus, are yet dependent to a last degree on the general vascular mechanism for their integrity. The body economy is so perfectly correlated in all its parts, and both section and elimination so seriously affect parts most distant from those in action, that local indication of systemic influence may be safely considered. It is the purpose here to determine then, how far in a special sense physical examination, such as that of the nasal turbinates, can indicate condition of general vasomotor action, and in this case the nasal mucous membrane is selected simply as a particularly representative vascular tissue.

In a series of diagnostic physical examinations of nasal cavity and naso-pharynx, we are probably most forcibly impressed with the turbinated features. Such examination, of course, includes careful estimate of septum, floor surface, vibrissae, superior, middle and inferior turbinates, and pharyngreat tonsil with perhaps added illuminated investigation of sinuses.

From a purely operative standpoint, possibly the condition of the septum might stand paramount, and this perhaps is seldom strictly normal, but in general judgment of the nasal cavity, and its ability to perform the functions, olfactory, respiratory, phonatory, and protective, which nature has assigned it, we study the turbinates with increasing respect.

To the novice, this routine and judgment seems trivial, but with more experience there comes with rude shock the realization of how many nasal cavities, condemned in our judgment, really afford but slight disturbance to the patient, and on the other hand of how many apparently trivial abnormalities and hypertrophies afford him genuine distress.

The subject will be carried on in these phases: (A) Classification. (B) Anatomy. (C) Group tests and statistics. (D) Deductions.

(A) Rhinitis, or more properly speaking, rhino-pharyngitis, has been broadily grouped in the following classification:

a. Simple rhinitis,
b. Hypertrophic rhinitis,
c. Atrophic rhinitis,
d. Sclerotic rhinitis(sequence of b),
e. Purulent rhinitis (sequence of c),
f. Vaso-motor conditions,
g. Specific and membranous affections,
h. Invasion of foreign bodies.

This classification, admirable in many respects, is confusing in that both hypertrophic and purulent may be specific in origin; again, the vaso-motor element, prominent in the first four groups, may still be first to reveal the presence of the foreign body; indeed, often baffled alike are both experienced practitioner and immature specialist in the diagnosis and therapeutics afforded by the complex walls of the nasal chamber. Add to this the cause and effect presented by a much convoluted and distorted septum, and the confusion is complete.

In our consideration, it is but fair to admit these difficulties; so misleading is the appearance of the nasal cavity, so frequently do gross turbinate processes produce no discomfort, and on the other hand roomy nasal passages afford such scant relief, and again so moderate are the changes sufficient to produce major obstruction, that over-reliance on surface indication is as fatal as underestimate of the same.

(B) On gross anatomy and accidental deformity, but little need be said, and passing by nasal deflection, of course a frequent cause of all the difficulty present and remediable by surgical intervention only, a nasal study naturally devolves into a consideration of the turbinated structures, the upper two springing from the inner walls of the ethmoid bone, and the lower independent, protecting the opening into the antrum of Highmore and overlapping the floor of the proper nasal passage.

In studying their structure, connection with the cerebral and sympathetic nervous system, tracing the etiology of quick vascular change and response to irritation, and again analyzing these laws of cause and effect in their relation to the adolescent period, we note firstly, that they present the most readily changeable and movable tissues in the nose, and are directly under influence of cranial and sympathetic nerves; secondly, are essentially vascular in their anatomy; thirdly, each protects openings to important sinus passages, and finally that together they perform in large part the total nasal function, both sensory and olfactory.

Anatomically (and here we must share their importance with the nasal septum) the turbinates consist of thin lips of bony shelving, curved in somewhat wood-shaving appearance, covered first by basic layers of fibro-elastic tissues in stroma containing nerves, lymphatic and glandular elements. Upon

this is a membranous layer, and it is outwardly covered with ciliated epithelium interspersed with goblet cells in the lower, respiratory portion, and by non-cilated epithelium mingled with special olfactory terminals in the higher, olfactory region. The nervous supply of special sense is through filaments of the olfactory nerve passing through the cribriform foramina, and that for general sensation is derived through branches of the fifth or trigeminal, through both ophthalmic and maxillary divisions. Branches from Meckel's ganglion and the vidian nerve practically complete the group. The vascular supply forms a vast communicating series, freely anastomosing in all parts, and comprised in the main of branches from the ophthalmic, internal maxillary and facial arteries.

This anatomic summary has been hastily and briefly given, as it but indirectly affects the topic, yet emphasizes the particularly important vascular and nervous relations. Due to this freely ramifying vascular supply, we find the nasal turbinates a typical erectile tissue, freely and quickly subject to vascular engorgement, if the return avenues for such congestion be temporarily closed.

Granting the above, we summarize this situation in the nasal picture as presented:

(a) A locality freely subject to vascular congestion from whatever cause.

(b) A hypersensitive vascular area open for free and serviceable study.

(c) A locality freely subject to metabolic change. In so far as these attributes be representative of vaso-motor influence, so far may they be considered indices of the same.

Clearly the period of life, varying as it does, in which hypertrophic, or as preferred by Dr. Kyle, hyperplastic, change has become well marked, and deformities in nasal position have produced irremediable organic defects, presents no opportunity for safe judgment, but in the earlier adolescent period, a far different status obtains. Here much is in the formative stage—an application of cocain or adrenalin reveals how largely the swollen turbinate structure can clear itself from true hypertrophic stigma.

Suppose such a subject in the formative period of life were to be under examination. Nasal chambers show passages largely blocked by enormous turbinates, and this in time asso-

ciated with general thickening of the entire nasal mucous membrane. By post-nasal mirror, we first attempt the elimina- of the enlarged pharyngeal tonsil. By speculum anteriorly we clear the suspicion of deflected and distorted septum, and its consequent points of pressure irritation. Polypoid degeneration and foreign bodies are next excluded, and the question of specific neuroses investigated by general symptomatology. By secondary, careful study we may perhaps eliminate true hyperplastic and sclerotic changes, and yet admit, that all these conditions are far from disassociated with the vaso-motor element, indeed, are most intimately connected with it, and must be given their place in such category.

With these functionally swollen turbinates before us still, after elimination of foreign obstruction, specific disease and misplaced septum, and reinforced by application tests of cocain and adrenalin, typical erectile tissue as it is, we have a vaso-motor focus of increasing interest and such causal possibilities as the following may present themselves in a rude way:

1. Acute rhinitis from known irritative cause. (This finally diagnosticated by accompanying symptoms.)
2. A general superficial vaso-motor dilatation from known cause and associated with vaso-dilatation throughout other parts of the body, such as blushing of the surface, frank perspiration, etc.
3. A possible evidence of general cerebral congestion.
4. A hypersensitive mucous membrane responsive to any suggestive influence encountered.
5. A congestive swelling closely following violent exercise.
6. A congestion periodic in its type.
7. Reciprocal congestion secondary to systemic illness.
8. Congestion due to disturbed metabolism.

This list might be extended, and many other vital conditions might show the metabolic relation to the general body economy. Inferences from these anatomic appearances are quickly and surely drawn.

(C) In the continuation of this topic, it having been the writer's privilege to be associated with much special and general physical examination, he would submit this preliminary report of conditions bearing upon this topic, not as conclusive in any degree, but as containing figures for further study and estimate.

In a small college near Philadelphia, a new form of physical examination and test was recently applied, one which had been recently suggested by Dr. Meylan, of New York, and in which, under a rather elaborate system, the following factors were taken into consideration: (a) Bodily control (series of four tests), one for upper extremities, one for lower, and two combined. (b) Vitality (a strictly endurance test). (c) Health (estimated one-half by examiner's grade assigned to general examination of heart, lungs and nervous system, and one-half by a series of fixed strength tests not involving co-ordination). This system certainly seems to be a rational one.

The opportunity had been previously taken to make special examinations of these same men as to condition of eyes, ears, nose and throat. Of these tests perhaps the most interesting was the vitality test taken under these conditions:

The candidate hung down between two parallel ropes with a known shoulder adjustment. To metronome accompaniment, once each second, he sprang to hanging position with hands opposite armpits, and then at next beat dropped to the floor, and continued this to exhaustion point. In observing these tests, fifty-one men at a given time took part, and as the age of the subjects was from 17 to 24, the sclerotic or hyperplastic turbinate was present to certain degree. Of these fifty-one men, fifteen by previous examination presented distinctly enlarged turbinates. Of this number nine men represented particularly free vaso-motor characteristics, and as to reaction time, seven would be considered of quick response, six moderate and three slow in type.

The results, meager as they are, may prove of interest, but, it is fair to admit, yielded nothing as conclusive as in tests to be described later.

Of the fifteen noted above as representing filled turbinated sacs:

1. In the special endurance test, nine were above and six below the group average.

2. In strength test, eight were above and six below.

3. In complete examination, bodily control (four tests), endurance and health (represented by physical examination and strength tests), nine were above the average and six below.

The general result then was rather in favor of men of acute vaso-motor type, but the number of candidates was too small for fair average, and the tests were non-conclusive.

A little over a year ago we made general and special examination of about 270 boys in a large boarding school near Philadelphia. Special note was made of all boys having deformed septa and enlarged turbinates.

Of this number (270), 52 were found possessing unusually large turbinates, and following the method above outlined, the writer has been investigating parallel conditions. Of this number, seventeen showed direct parallel conditions. Of this naso-pharyngeal obstruction, such as enlarged faucial and pharyngeal tonsils or thickened walls; eleven had marked manifestations of nasal septum deformity (deflection or spur). This leaves twenty-four men who might be classified as under a more or less definite vaso-motor influence, though the first group may also in part be secondary to this. In fact, three more, one from constantly recurring autumnal catarrh, and two from general systemic disturbance, might be excluded from the classified list.

Taking then these two groups, Class a contained thirty-one with distinctly causative obstruction and Class b twenty-one rather clearly vaso-motor conditions. The following estimates resulted:

1. Nineteen were classified at the time of the examination as of particularly active nervous system, nine in Class a and ten in Class b, while all but six of the remainder were put in moderately active nervous group.

2. In reaction time of the entire group, twelve showed highest response and thirty-one moderate, leaving but nine of poor reaction period.

3. In vaso-motor examination such as blushing, perspiration, general superficial temperature changes, and possibly associated pilo-motor activity, twenty-four were marked positive with the larger proportion of the remainder in the medium list.

4. In heart examination, twenty-five were recorded as perfect, twenty-three of modified integrity with slight functional disturbance, such as, hemic murmurs, nervous palpitation, or temporary dilatation, and four with a slight organic defect, more or less pronounced.

5. In general health, twenty-six were marked good, twenty moderately good or fair, and six distinctly poor.

6. As a matter of interest the scholarship question was in-

vestigated with the result that thirteen were considered good students, twenty-three medium and sixteen poor, but this seems hardly in any way indicative.

Conclusions from the above evidence are of course merely tentative and unsupported by sufficient corroboration, and averages again far too meager. They are impressive, however, and in toto present sufficiently distinct correlations to grant some deduction.

In the above statistics it will be noted that only in the first group have Class a and Class b been distinctly differentiated, and in explanation it may be said that at the time of the examination the differentiation in the remaining classes, two to six inclusive, was not sufficiently clearly indicated for announcement in this paper, and also these latter groups are included in a larger computation to be taken up later.

It seemed best to the writer, therefore, to state the averages for the present time upon the gross number of cases reported, and to submit these results as a preliminary report.

(D) Possible conclusions from the above: Granting that in the nasal cavity we possess a most highly sensitized vascular erectile organ, and readily accessible to examination, this in the early period of life is particularly sensitive to vaso-motor influences, and apparently holds a coordinated relation to general vitality and offers assistance in the gauging of metabolic change.

To substantiate this, other vaso-motor tests may be applied. A search into the general life and history of the individual indicated by these local examinations may reveal much of neurotic influence; the influence of sympathetic changes in abdominal physiology may possibly be found; again this may prove the key for the detection of associated sexual excess, or even may reveal the reflex vital disturbance from sexual irritation of deformity. In fact, redirection of the subject's entire life might in remote cases be a providential leading from studies of vaso-motor changes.

It would be unfair and foolish to place too much credence on diagnosis by isolated symptoms, yet in the search for truth we seek to attain all safe landmarks and directions leading to permanent health, and assign to that term its best and highest sense.

To the true diagostician, brawny muscular development,

powerful hypertrophied heart, hypersensitive motor and sensory nerve reaction do not mean health, but far more those latent qualities of clear eye ground, soft, velvety skin, normally vascular and undisturbed mucous membranes, resilient muscular action, regularity of all secretions and excretions, deep, clear respiration, a pulse regular in volume, rhythm and vis-a-tergo cardiac pressure, indicative of strong valvular action.

Deranged vaso-motor responses are imperative, and herein lies the value of vaso-motor evidence. Its advisory indications will be both prohibitory and stimulative.

This paper is presented without apology as a preliminary report, holding no claims but those of suggestion, and it is most respectfully added to the accumulation of contemporary testimony.

XXXVIII.

POST-OPERATIVE MENINGITIS.*

By Thomas J. Harris, M. D.,

NEW YORK.

In the opinion of many otologists, the method proposed by Stacke — or some modification of it — for radically attacking the disease in suppurative otitis and in securing a permanent cure is the greatest achievement in modern otology. Its enthusiastic advocates feel that they can best describe the condition of hazard to life, to which a victim of chronic otorrhea is exposed, by saying that he is living continually over a volcano. No unbiased observer can fail to be impressed by the justice of these claims. Nor is it our purpose to attempt to diminish in one iota the praise which rightly belongs to this important procedure. It is rather to a complication, much to be dreaded, which can follow the operation—which has, indeed, followed it in not a few instances—viz., meningitis, that we desire briefly to call attention.

At the meeting of this society in Atlantic City two years ago, Dr. Wendell C. Phillips reported two fatal cases of meningitis following the radical operation. One of these may have been suffering from a latent meningitis, but certainly there was no suggestion of it on superficial examination. No record of the temperature had been taken before operation. The writer, who was permitted to see the case, cannot help feeling that the operation was directly responsible for the meningitis. In the discussion which followed, Dr. Jack recited the history of a fatal case of meningitis following in twenty-four hours the radical operation. In the same discussion, Gradle was quoted as saying that of 126 radical operations in one of the Chicago hospitals eleven, or practically 8 per cent, had resulted fatally.

A short time ago, we had occasion to investigate the otitic statistics of two leading special hospitals. In one there were records of eighty-three radical operations. Of these, ten resulted fatally from meningitis. In the other institution, seven fatal cases followed the radical operation. These figures give

*Read at the Annual Meeting of the American Otological Society, held in New York, June 26, 1906.

us pause for thought. Seventeen fatalities in two hospitals where no question can arise about the high quality of the work performed. In the one instance a death rate as high as 12.5 per cent.

Human nature is the same wherever found. No man cares to publish abroad his failures. It is impossible to say how far, if at all, these statistics are in excess of the average. Certain it is that in a diminished ratio, at least, these untoward complications are occurring every day in the hands of us all. No thoughtful man can help asking himself what meaning and weight should be attached to such results. We cannot rightly shut our eyes to them nor pass them over by a mere haphazard explanation. It cannot be gainsaid that it is just such accidents that give our specialty a black eye among the profession at large, as well as among the laity, and are the occasion of that common observation that in the case of the ear the "let well enough alone" policy is the best.

At the outset it must be admitted that a correct appreciation at the present time of the question under discussion is difficult, if not impossible. Many factors enter which are hard to justly estimate. To draw the conclusion that the radical operation is rightly responsible for a large number of fatalities due to meningitis, we must know (a) what has been the result in this respect following the long performed simple mastoidectomy; (b) how many cases, otitic in origin, occur without operation; (c) what was the condition of the meninges in the fatal cases, preceding operation. In other words, were there present signs of an already existing meningitis?

These and many other suggestions will naturally suggest themselves, an answer to which is essential for a correct estimate of the significance of post-operative meningitis. It is obvious that this can be only partially or approximately arrived at.

Acute cases demanding immediate operation do not enter into consideration here. No one can pronounce in advance positively how extensive is the involvement in such cases. We are concerned only with the chronic type, operated upon without any pressing symptoms.

As regards meningitis following the so-called Schwartze operation, it can be frankly said that it occasionally occurs. In the statistics of the Manhattan Eye, Ear and Throat Hospital, just alluded to, there are records of twenty cases of men-

ingitis following the Schwartze operation in 1,112 operations, or one in fifty-five. Here the same rule would apply, however, namely, only simple, uncomplicated, chronic cases developing meningitis should be considered. Of these, there were only seven. How many operations there were for chronic otorrheas is not stated, nor how many had acute complications. Of the twelve fatal radicals, eight were for chronic otorrhea.

Meningitis Following Otitis Without Operation.—A second consideration in the question under discussion is, how frequent are the fatalities from otitic meningitis where no operation has been performed. It will be recognized that any exact figures in this respect are impossible. The attention paid to the ear by the profession has greatly increased and the ability to recognize and properly handle otorrhea has wonderfully improved. In consequence, the number of intracranial complications has been decreased. Yet beyond question a considerable number of such cases are constantly occurring. Many of them are probably unrecognized, or the true condition discovered after all surgical interference is deemed unjustifiable. Of such we can expect no account, whereas a fairly correct record of operative cases is possible, as they are for the most part operated upon in hospitals. Certain it is that we have a right to regard such unoperable cases as a factor in drawing our final conclusions.

Latent Meningitis.—Much more deserving of consideration is the view commonly advanced that all of these cases of post-operative meningitis are in reality cases of unrecognized meningitis at the time of operation. There is little question that instances of this do occur. All operators are not equally painstaking in their preliminary examinations. Doubtless, too, certain cases of meningitis are difficult or impossible to diagnose from the symptoms alone. Yet such cases are so rare as in no way to justify this contention. This has been conclusively shown by Zeroni (Arch. für Ohrenheilkunde, Vol. LXVI., p. 226), who has made an exhaustive study of the subject, in the course of which he collected forty cases of post-operative meningitis in which autopsies had been performed. In only three of these was there any evidence from the histories before and after the operation to show that a previous latent meningitis existed. However latent, it must be admitted that some temperature would occasionally be present, as well as other symptoms of localized inflammation. This was not the case.

The seventeen cases of which I found records do not give complete data on this point. Among them, however, there were eight following chronic suppurative otitis where such data are given. Of these, all but one were free from temperature on admission to the hospital.

Imperfect Drainage.—A far more important cause is to be found in imperfect drainage of some suppurating focus following the radical operation. The cases we are considering in many instances represent purulent processes existing for years. There are, as a rule, in consequence, extensive bone lesions. These areas have had a constant free outlet, and so the possessors have experienced little discomfort. It is the purpose of the operator to eradicate every bit of disease. This we now recognize is well-nigh impossible in some instances. Our search demands not rarely free exposure of the dura. This is not infrequently skin-grafted at the time of operation. In any case, a firm packing is applied to the entire wound. We have no guarantee that we have not after all left untouched some hidden focus of disease, and yet ye greatly hinder, if not block, all egress of discharge. What can be more natural than that under these conditions the brain membrane should receive the force of the infection!

The records of these many cases just quoted—all without elevation of temperature upon admission, show temperatures of 103° and 104° developing as early as the second, third and fourth days. This can only mean that a very weighty factor in producing post-operative meningitis is a failure to thoroughly eradicate the disease, combined with a stoppage of the previous outlet of discharge.

Faulty Asepsis.—To the previous cause, and closely connected with it, are to be linked faulty technic and imperfect asepsis. In our judgment the operation is one of the most delicate in surgery. In the hands of a beginner it cannot but be fraught with serious risk of life. The field is a deep, narrow one, surrounded by vital structures. The exact anatomy is difficult even to the experienced operator, at times. The time element in operation is no inconsiderable factor in the avoidance of shock.

Disease of the Labyrinth.—According to the statistics of Zeroni, however, the most common cause of post-operative meningitis (where the ear is considered) is disease of the labyrinth. His contribution in this respect is full and convincing. Of the

forty fatal cases collected by him, twenty-nine at the autopsy showed evidence of chronic labyrinthine disease. The extent of involvement varied. In certain instances it was limited to a single area, as one semicircular canal or one window. More often there was extensive caries and suppuration of considerable areas. There was every indication that the process was a chronic one. Whether the operation served to excite an acute exacerbation of this chronic process, it is not possible in most instances to say definitely. In certain cases, however, the post-mortem evidence on this point was clear. The route of infection was determined in the majority of instances. In seventeen a perforation of the inner wall of the middle ear was discovered. The majority of these were in the oval and round window. In several instances the foot-plate of the stapes was dislocated or fractured. Less often, an opening in one of the semicircular canals occurred, suggesting the greater risk where the round or oval window was involved. In the remaining twelve cases, no perforation was recognized. How the infection entered in these cases it is hard to say. It is very possible that the perforation was overlooked. An anastomosis, pathologic in origin, of the blood vessels between the middle and inner ear can also account for it.

Of particular interest is the question: In what way is the operation responsible for this invasion? Most authorities ascribe it to the jarring effect of the mallet. That the chisel is guilty of causing harm, there can be no question. On that account certain distinguished operators never use it. But the chisel cannot be responsible for all these complications, for in two cases it was not used. In one, only granulations were curetted from the middle ear.

Zeroni admits the difficulty in many instances of diagnosing labyrinthine disease in advance. Certain characteristic symptoms, such as nystagmus and vertigo, may be lacking. But whenever it is recognized or strongly suspected, he urges that great caution be used in deciding upon operation; and when decided upon, that extra care be taken to avoid all manipulation in the middle ear. Indeed, as a general principle, he would insist that great conservatism be exercised in attacking the inner wall of the tympanic cavity, in spite of the fact that an incomplete operation may in this way be done. Especially is rough sponging to be avoided in this locality.

Jack, in the discussion of Phillips' paper, gives his opinion

as follows: "The subject of the radical operation is very important, and one we should consider carefully, for some time. At present I do not think we can advise a patient in perfect health with the exception of a chronic middle ear discharge, to have this operation performed as a cure for the otorrhea without carefully considering the risk of permanent injury to the facial nerve, or of life itself."

As a result of this imperfect study, we desire to draw the following conclusions:

1. That valuable a procedure as is the radical operation upon the ear, it is as an operation by no means free from danger to life and should not be entered upon lightly where otorrhea alone is present, nor until a resort to other less heroic measures has been practiced.
2. That its most serious complication is meningitis, which would appear to be by no means infrequent.
3. A careful aural examination is imperative before operation, especially of the inner ear, as well as an observation of the patient for a sufficient time to exclude a possible latent meningitis.
4. That postoperative meningitis is due to a number of causes, of which obstruction to proper drainage of some unrelieved focus of disease and chronic disease of the labyrinth are the most important.
5. That accordingly it behooves us to exercise the greatest caution in operating for simple otorrhea when labyrinth disease is recognized.
6. And finally that especial and scrupulous care is to be exercised in every detail of the operation as regards asepsis, closure of wound where dura is exposed, unnecessary jar from chiseling and securing a complete eradication of all disease.

XXXIX.

MODIFIED BLOOD CLOT IN MASTOID SURGERY.

By W. Sohier Bryant, A. M., M. D.,

NEW YORK.

The clot has given excellent results in the hands of Blake, Sprague, Reik and many others, while a number who have tried the method have given it up on account of the infection which followed closure of the mastoid wound. More recently Blake and Sprague have reported their results of closing the mastoid wound around a small drain. H. L. Mour of Boston has used this method very successfully for nearly twenty years. The drain allows the application of the clot to a much larger series of cases than the simple clot, which is useful only in carefully selected cases. Comparatively complete surgical asepsis is not required for the wound if a drain is to be used, while it is necessary for success with the simple blood clot. This drained clot makes a compromise between the method of packing the wound and the clot plain and simple. It allows a maximum healing by first intention, while at the same time a small portion of the wound is reserved for drainage. Formerly the drainage was left in for a week or more and then removed, and the wound allowed to close.

I now practice what seems to me an improvement on this method, namely, early removal of the drain. I find that a small cigarette drain seems to be sufficiently large to accomplish the desired result of lessening infection, and its removal after twenty-four hours allows a considerable flow of serum, which is followed by closure of the entire wound by first intention. Should the wound become infected it does so early, and the opening left by the removal of the drain furnishes free drainage through the clot. I have tried this method in a variety of cases and have found it to work satisfactorily in all, as it insures a short convalescence, a good cosmetic result and decidedly better hearing than slower methods. I now use it in all cases except those where a macroscopic amount of necrotic tissue for some reason must be left in the wound. It seems probable that if the clot method were tried with our modification it would be more generally used.

My experience with this modification of the drained blood clot has been very satisfactory, even in those wounds which

developed post-operative infection and the final results have been very gratifying compared with the best results by the method of packing, while the cases which are not infected heal by first intention quicker than after the simple clot and the convalescence is shorter than in the reported cases of drained clot.

Simple mastoid operations, mastoid operations with epidural or episinuous complications, and the radical operations have all given me better results, after this method was used, than they did by the simple clot or by the clot with a drain left in for some days.

Even in the cases which might have been selected for the simple blood clot, this method gave a little better result than with the simple clot itself. I have not tried it in those cases where it was obvious that all the necrotic tissue could not be removed.

In my simple mastoid operations treated by the clot dressing, healing of the post-aural wound has taken place on the average in six and one-half days. The middle ear has been dry in thirty-seven and one-fourth days. Treated by our modification of the drained clot, the healing of the post-aural wound has been complete in five and one-half days and the middle ear dry in eight days, which makes the proportion six and thirty-seven to five and eight for our method. This shows a decided advantage for our drained clot.

In the radical operations treated by the clot dressing the post-aural wounds have healed on the average in ten days, while the middle ears have been dry in twenty-one and one-half days. The average result of cases of radical operation treated by our drained clot shows the healing of the post-aural wound in nine days and the middle ear dry in twelve days, making the proportion of ten and twenty-one to seven and twelve for our method. This shows a decidedly better result than by other methods.

Cases of epidural abscess do not indicate the use of the simple clot dressing, but they do very well with the drainel clot. The cases treated by our drained clot, on the average, had the post-aural wound healed in fourteen days, and the middle ear dry in seven and one-half days.

Illustrative Cases:

Case I is a case of uncomplicated mastoid operation which might have been treated by simple clot. It shows a very sat-

isfactory result under the use of the drained clot. The operation was done on a child for acute mastoiditis. A cigarette drain was inserted and the wound allowed to fill with blood. The wound was healed on the second day, except at the exit of the drain, which was then removed. The middle ear was dry on the seventh day. The highest temperature after the operation was 99.04° per rectum on the day after the operation. The cosmetic result is perfect.

Case II is a case of uncomplicated mastoid operation where the simple blood clot was contraindicated because of the extensive involvement of the parts which it was not expedient to wholly remove. It shows a good result with our drained clot. The patient was a child with a large subperiosteal abscess and acute mastoiditis with extensive involvement. The wound could not be excavated till healthy bone was found in all directions. After the operation the wound was flushed with salt solution, a cigarette drain inserted and the wound allowed to fill with blood. The meatus was packed with gauze. The temperature was normal after the operation. The drain in the wound and the gauze in the meatus were removed on the second day. On the eighth day the wound was healed completely and the middle ear dry. The cosmetic result was perfect.

Case III. The patient was a young woman with chronic middle ear suppuration and tympanic caries. The usual radical operation was done. The dura was uncovered over the knee of sinus and antrum. The wound was flushed with normal salt solution. A small drain was placed in the lower angle of the wound which was closed and allowed to fill with blood. The meatus was lightly packed with iodoform gauze. On the next day the gauze drain was removed from the wound. On the sixth day, the post-aural wound was healed and the middle ear was perfectly dry. The highest temperature was reached the first night, 100 6-10°. The cosmetic result was perfect.

Case IV. A case of mastoid operation complicated by a large epidural abscess and erosion of bone treated with our drained clot. The recovery was rapid. The patient was a young man with acute middle ear suppuration, mastoiditis and epidural abscess. The usual mastoid operation was done. The dura mater, posterior to the mastoid antrum, was found covered with granulations and the inner table of the bone deficient over a large area. The wound was washed with salt solution.

allowed to fill with a blood clot. The meatus was packed with iodoform gauze. The highest temperature, 100°, was reached in the first twenty-four hours. The day following the operation, the drain was removed from the wound and the gauze from the meatus. On the 15th day, the membrana tympani was healed and perforation closed. The post-aural wound was also closed and completely epidermatized except a tiny spot at the former seat of the drain. The scar is very small and the post-aural surface almost perfectly smooth.

Our modified clot offers many advantages which are sufficient to warrant its trial even by the practitioners who have not met with success after using the simple blood clot.

DISCUSSION.

Dr. W. C. Phillips, New York, said that so far as his experience was concerned and knowledge of the work as it was done in New York in the large hospitals among the ward patients, all attempts at rapid healing by means of blood clot in any form had met with almost invariable failures. He has been surprised at the cases reported by men in other cities, especially those of Sprague and the men working in Boston, because the results among the class of outdoor patients that are found in the great metropolis are not good. Whether it is due to faulty technic or not he was not prepared to say. It did not seem possible to sterilize absolutely such a field and retain it so, and keep a blood clot clean and free from infection. The wound always communicates with the middle ear, giving two sources for infection. He was very skeptical and hardly thought the operation a fit one for general adoption.

Dr. E. M. Holmes, Boston, was very much discouraged with its use. It has been his experience in Boston that they resulted badly whether they were in or outside, and yet Dr. Bryant's suggestion was a new one. He thought perhaps he might have another opportunity to try it with the modification of a cigarette drain. With acute cases there seemed to be the same opportunity to make the same opening for flap operations, and if there was any method by which convalescence could be shortened, he would be glad to avail himself of it.

Dr. W. C. Bane, Denver, said, in his limited experience with the blood clot in mastoid wounds, he had found it unsatisfactory. The wound became infected and had to be cleaned out. There is nothing to be gained by its use.

Dr. W. S. Bryant, New York, closing, said that the chief points in the technic were to watch the convalescence and fairly good results were obtainable. He thought the reason failures were so frequent in New York was because the dressings were usually given over to the internes who were not as careful as the operator. He suggests taking out the drain in 24 hours. If suppuration should occur he advises a free opening. He expected healing to occur by first intention even with a drain.

XL.

THE MEDICAL TREATMENT OF TUBERCULOSIS OF THE UPPER AIR PASSAGES AND THE EAR.

By Wm. C. Bane, M. D.,

DENVER.

The medical treatment is naturally considered under two heads: constitutional and local.

1. *Constitutional:*

Theoretically, much might be hoped for by systemic medication, but, unfortunately, comparatively little is accomplished. New remedies are brought to our attention from time to time, and lauded as cures of the white plague, only to be found wanting when put to the test. The drugs that aid in stimulating the appetite for food, and the enriching of the blood, do accomplish much in assisting nature in overcoming the disease. Experience has demonstated that strychnin is the best stimulating tonic for tubercular patients. The hypophosphites have some value, and may be combined with strychnin.

Certainly the most efficient destroyer of the tubercle bacilli is rich blood. Hence the importance of a full nourishing diet of meats, eggs and milk, supplemented with emulsions and fats. Creosote and guaiacol have a value in stimulating an appetite and toning up the system. They may be combined with malt or some of the oleaginous preparations. Calcium chlorid is given by some physicians with the idea that it has a beneficial effect in overcoming the disease.

Forced feeding, coupled with rest to the system, is very important in aiding nature to combat the disease. The cough should be kept in abeyance in order to give rest to the diseased parts, particularly the larynx, and this is best accomplished by some of the alkaloids of opium, as codein or heroin. Not only does the codein quiet the cough, but it aids very materially in relieving the pain, both very important points in the treatment.

2. *Local:*

The local treatment of tubercular laryngitis depends upon the stage of the disease and the amount of destruction that

has taken place. Likewise, upon the object aimed at, i. e., whether palliative or curative. In the far advanced pulmonary cases, with markeed destructive changes in the upper air passages, but little more than palliative treatment is to be considered. But in the cases of infiltration, or even ulceration, with fair condition of the lungs, vigorous efforts should be put forth to check the local disease.

Whether the disease be in the nose, pharynx, larynx or ear, it is desirable to keep the surfaces as free from mucopurulent secretion as possible. As a cleansing solution, and at the same time possessing some anesthetic properties, I am partial to a 4 per cent solution of resorcin. It can be used freely by the patient at home.

A 1-1000 solution of alphozone is an excellent preparation for cleansing the larynx. Being germicidal and but slightly irritating, it can be used freely.

The most efficient remedy up to the present time is formalin, whether in the filtrative or ulcerative stage. It is irritating to some patients, but the irritation is only transient. Formalin is decidedly germicidal in even a weak solution, and serves for not only cleansing the larynx and pharynx, but in a comparatively strong solution, 1-500 to 3-100, for direct application with a swab to the diseased areas. In most cases the formalin, in strong solution, should be preceded by the application of a 5 to 10 per cent solution of cocain or eucain B. A 3 to 5 per cent solution of formalin has a decided beneficial action on ulcers of the larynx, and may be applied to granulations about the epiglottis and vocal cords. It causes shrinking and hardening of the tissues, thus encouraging fibrous changes.

Lactic acid is a local remedy of value in the ulcerative stage when it is desirable to destroy tissue. Dr. L. B. Lockard* of Denver has had a very large experience with the local use of formalin in tubercular laryngitis, and he regards it as superior to all other remedies. I wish to state in this connection that I am indebted to him for his views on the treatment of tubercular laryngitis, and have embodied some of them in this paper.

The essential oils have some value, yet when used in sufficient strength to avail much, they act as irritants. Their principal value is in overcoming the fetor, in part.

*The Laryngoscope, October, 1904.

Possibly the best instrument for the patient to use for cleansing the nose and throat is the Devilbiss No. 16. It is easily handled and can be readily sterilized.

For local anesthesia, there are several drugs at our disposal. Eucain B in a 5 per cent solution has a good effect and interferes less with local nutrition than cocain. It is less toxic than cocain. A safe and most efficient local anesthetic is orthoform applied by insufflation with boric acid, or in an oil. Dr. Lockard recommends a mixture of orthoform, viz.:

Orthoform	grs. xv.
Menthol	dr. j.
Ol. olive	oz. j.

Inhale for 5 or 10 minutes every 2 to 5 hours.

The medical treatment of nasal or pharyngeal lesions is that outlined for the larynx. Where the tonsils are involved it is necessary to swab out the crypts thoroughly with a solution of formalin or lactic acid. A very strong solution of alphozone also meets the indications. We perhaps pay too little attention to the tonsils in tubercular patients. It is certainly true that one source of involvement of the cervical glands is through the tonsils and connecting lymphatic vessels.

The ear is invaded insidiously, and as a rule without pain. Too much care cannot be taken to prevent the tuberculous mucus from entering the Eustachian tubes. The manner in which many people blow the nose tends to force the infected mucus into the tubes. The cleansing of the vault and nose with a germicidal spray is very desirable to avoid involvement of the ears. In the early stage or that of infiltration and maceration, the hearing being impaired, and a full feeling experienced, without pain, the patient seldom applies for aid, except when one ear has already been damaged. In this stage an effort should be made to empty the tube and middle ear by suction and medicated vapor, as of iodin and methol, gently forced into the middle ear. After rupture of the membrana tympani has taken place, it is desirable to keep the canal and middle ear as dry as possible. The patient should be taught how to dry the ear with cotton on a cotton holder. Once every second or third day, the canal, ear and tube may be treated by instillation of a 3 per cent solution of formalin, preceded by a 5 per cent solution of

eucain B. I do not favor frequent irrigation of the ears in these conditions. They do best under a comparatively dry treatment. The long and faithful carrying out of the above line of treatment will bring about a dry condition of the ear and check the tuberculous process, if the general condition of the patient has improved. The hearing is usually permanently impaired.

In Colorado, we see a class of patients that are practically well of their pulmonary disease, yet in whom the hearing in one or both ears is impaired. The drum membranes contain one or more perforations of varying size. There is a varying amount of secretion that is thrown out from the middle ear and dries on the edges of the perforation, and in time covers it. These patients consult us at irregular intervals to have the dried masses removed. When left too long, maceration beneath the mass occurs and the ear becomes foul. We find it best, as a rule, to loosen the edges with some form of liquid before attempting removal. The instillation of eucain B followed by formalin, will in time check the secretion and effect a cure.

Occasionally the subacute destructive process progresses and there results a loss of the lining of the middle ear and necrosis of the promontory. The medical treatment in such cases is mainly that of keeping the parts clean.

When the disease invades the mastoid much can be accomplished by irrigation with alphozone, and the external application of ichthyol and glycerin. While I have seen a goodly number of tuberculous ears, the cases with pronounced involvement of the mastoid have been very few, indeed. Not over 3 per cent of my operations for mastoiditis have been on cases of tubercular origin.

XLI.

THE CLIMATIC TREATMENT OF TUBERCULOSIS OF THE UPPER AIR TRACT.

By Wolff Freudenthal, M. D.,
NEW YORK.

It is an old and common experience that the majority of pathologic conditions are beneficially influenced by pure, fresh air. More difficult, however, is the answer to the question: in what affections can a marked relief or cure be expected by a change of atmospheric surroundings? The disease of interest to us in this discussion is tuberculosis of the upper air tract. Since we cannot separate those parts from the rest of the body, we should not ignore the condition of the lungs, which, as a rule, are also affected. On the other hand, it is my conviction, based on a considerable experience, that the diseases under consideration require a special climate in some instances.

First of all, it must be borne in mind that tuberculous cases are being cured in all parts of the world, i. e., in every possible climate. Still the difference, for example, between a high altitude and the seashore is so great in a physiologic sense that in pathologic conditions a beneficial or a deleterious influence might be expected from either of these localities; and, as a matter of fact, such influence for better or worse does exist under different climatic conditions, for you will all agree that some of your patients have done well in southwesterly altitudes, while they become worse when they return to their homes in the East. Why is it that these relapses occur so frequently? Is it because these people resume their old occupations? No! Some of them — women — have no vocation, while others follow their business in the West for many years without detriment. This is undoubtedly due to the influence of the climate, and in the following pages it shall be my aim to discuss briefly the treatment of tuberculosis of the upper air tract from a climatological view-point.

For the sake of convenience, I have thought it best to divide the subject into four parts:

(*a*) Aerotherapy.
(*b*) Heliotherapy.
(*c*) Altotherapy.
(*d*) Thalassotherapy.

(*a*) *Aerotherapy* is the treatment with fresh, pure air, which a priori we should be able to utilize everywhere, and in fact we do make use of it all over the world. What diet means in catarrh of the intestinal tract, aerotherapy means in catarrh of the air passages (Nothnagel); or, we may add, in tuberculosis of the air passages. If we take a patient away from his sweatshop, direct him to do half a day's work if he cannot give up work entirely, and let him spend as much time as possible in some park in the open air or, in smaller towns, in the fields, such a patient has actually changed his climatic surroundings. If necessary, his throat and nose can be treated at the same time, and in a number of cases we will be rewarded by a cure.

If the patient is somewhat better off and can stay away from business for several months, so much the better for him. We can then place him in a sanatorium nearby, or he can present himself at regular intervals for treatment. By far the great majority of all consumptives must be treated in that way, and I am sure there is not one physician in the United States who has not obtained cures in that manner.

The details of using air as a therapeutic means in tuberculosis are so well known that I need not dwell on this topic any further. However, let me ask you not to go into fads. The following case may illustrate what I mean: A well-nourished gentleman commenced to cough, and a diagnosis of incipient tuberculosis was made. Consequently he was ordered by his physician to stay in bed on a strict diet, to be massaged three times a day, and directed to have a tent built on his house opposite Central Park, in order to obtain more fresh air. These orders were carried out strictly for a week, when this gentleman and his wife were so exhausted from excitement, worry and lack of sleep that they told me they could not stand it any longer. On my examination, the condition of the lungs gave a reasonable doubt as to the correctness of the diagnosis, but there were present marked pharyngitis and laryngitis. I told the gentleman to eat whatever he wanted, to be out all day long and to have his throat treated. After eight weeks he had gained ten pounds in weight, and, having settled his business affairs, I sent him to the mountains. His cough had left him long before. I am convinced that this patient would have gone rapidly into

consumption if the former method of treatment had been continued.

It is very true that a consumptive cannot get too much fresh air, but to suddenly transplant a person susceptible to drafts from a hot room in New York City to cold winter air day and night is irrational, to say the least. On the other hand, even in the best of climates patients often do not get enough air. Some people think that when they live in the open air while taking the rest cure, they have done enough. As you know, however, the gaseous exchanges are only partly carried on by the lungs, and a great deal is done by the skin. Hence, we ought to expose the skin as freely as possible to the air, since parts of the lungs are out of function. A sojourn outdoors brings one in contact with the movable air, which is an essential factor in stimulating the skin, and through it the organism, to renewed activity. This is also the reason why we should accustom our consumptives slowly to wearing as few garments as possible, and finally to take air baths with the naked body. With this we have reached the second part of our discussion.

(*b*) *Heliotherapy.*—The therapeutic use of the rays of the sun is older than medicine, but their action on the human organism has been explained scientifically only in late years. I need but mention the names of N. R. Finsen, W. Gebhardt, Möller and Schönenberger, and they will bring to your memory a great deal that has been achieved in that field.

While the direct rays of the sun have been chiefly employed in order to promote perspiration, nowadays a combination of the diffuse sun rays, with exposure of the naked body to the air, is being utilized with success. By exposing the whole body to the air not only is the exchange of gases through the skin accelerated, but at the same time, through the action of the sun, the metabolism is increased and finally a beneficial influence is exercised upon the nervous system.

Says Prof. Rieder of Munich: "The question has been brought up whether it would not be preferable to let the patients go around naked in glass houses, instead of subjecting them to the fresh air cure, as is customary in sanatoria." This question has been answered in the affirmative by others, and I am personally very much in favor of such a combination, only I should advise that this cure should be

carried out in the open air instead of in glass houses, as Rieder suggests (Handbuch der physikalichen Therapie von Goldscheider and Jacob, Bd. ii., p. 502, etc.).

That we can also use the direct rays of the sun for this treatment, I have mentioned on various occasions. Permit me only to repeat that one of the first directions I give to my patients is to stay in the sun as long as they possibly can; that is, in winter. In summer they are advised to rise with the sun and expose themselves to its rays. In warm climates, as well as in our own, this has to be done later in the day with more care and judgment. But even in the hot regions of Colorado, New Mexico and Arizona I have had patients working on ranches for many hours every day and they fared well. But not everybody can stand this, and we have to discriminate here as in everything else in medicine. We should remember that exposure to the sun does not act therapeutically through its intensity, but rather through its continuity. Too much exposure has a weakening, deleterious effect, and spoils the appetite, but taken in the right way it has done good in a general way. As to treatment of the upper air tract, I have noted some good effects in so far as relief of pain is concerned. As a substitute for the sun, the arc light has been used, and while it is not a panacea, it is nevertheless a good adjuvant to our armamentarium in such treatment.

(*c*) *Altotherapy.*—I have coined this word myself—at least, I do not remember having read it anywhere—to indicate treatment in high altitudes This treatment is of great, if not of paramount, importance to our tuberculosis patients. There are four features which characterize high altitudes:

1. The pressure of the air. This being highest at the level of the sea, gradually diminishes with the altitude, and with it likewise the density of the air.

2. The intensity of radiation of the sun. This (i. e., the rays of heat), on the contrary, increases with the altitude and level of the sea, gradually diminishes with the altitude, and independently of the heat of the ground.

3. The rays of light. Their intensity is also increased, and, according to Prof. A. Loewy of Berlin, it is especially the chemical, short-waved rays—the blue and violet—which are present in high altitudes and make themselves felt more strongly than at the level of the sea.

4. The temperature of the air. This diminishes with the

elevation. Of course, that varies with the geographical latitude, and is due partly, as we know, to the decreasing density and diminished humidity of the atmosphere.

Now these atmospheric conditions prevailing in high altitudes have a more than merely perceptible effect on the human body under normal conditions. Can we believe that they are negligible in pathologic processes? We know that good work is done in sanatoria situated at the sea level, but does this imply that climate as a factor in the treatment of tuberculosis can be ignored entirely? If our home sanatoria were less careful in selecting by preference incipient cases or such where the diagnosis is still in doubt, one would see how quickly the mortality would rise. I have advocated the erection of sanatoria in and near New York, myself, and I know that for cases with slight local lesions, cases which are quite well nourished, they fill a great need. On the other hand, cases with marked anemia, febrile temperatures and irritations of the mucous membranes do much better in the mountains. This is also the experience of A. Fraenkel of Berlin (see his excellent work on Lungenkrankheiten, Berlin, 1904). Patients with much expectoration from the lower or upper air tract should be sent to a dry climate; while others, with a dry, hacking cough, do better in a moist climate.

In most of the text books, it is stated that tuberculosis of the larynx or pharynx is a contraindication to a sojourn in high altitudes, as it is a complication of pulmonary tuberculosis that retards or prevents the cure of the latter in these altitudes. Such and similar statements go from one text book to another and are accepted as truth. They are certainly not in accordance with my experience. Among my patients, there are some now living in New York City in good health and following their occupation for the last five and even ten years, who have been suffering from pulmonary and laryngeal tuberculosis (one with deep ulcerations in the lung). They were sent by me to Denver, Colorado Springs, parts of Arizona and New Mexico, and were perfectly cured there in spite of their laryngeal affection.

The trouble is that a great many of these cases represent an advanced stage of the disease, with a derangement of one of the vital functions of the body, namely, digestion. I say digestion purposely. The tuberculous involvement of the larynx only in extremely rare cases interferes with breathing,

i. e., with the respiratory tract; but too often when dysphagia is present it interferes with nutrition. Now to send a patient to a high altitude who has been debilitated by lack of food, whose heart is fluttering with every movement and who has not sufficient vitality to become acclimated to the new surroundings—that is like stretching a piece of rubber to see whether or not it will break.

On the other hand, there are quite a number of those afflicted with laryngeal tuberculosis who have enough vitality and energy to become accustomed to new surroundings, whose hearts will do this somewhat increased work without any damage, and whose dysphagia can be kept under control. Many of these will derive a great deal of benefit from a stay in high altitudes. Persons suffering from dysphagia should be sent to some place where there is a laryngologist who knows how to handle such cases. It is not at all to the credit of some sanatoria that they neglect the treatment of the larynx almost entirely, and it is not a rare exception for a patient to complain of pain in his throat and be told that he has a cold. It is true that we cannot cure all these cases, but it is only a short time since, while I was preparing this article, that a patient came back from a well-equipped sanatorium in the mountains because no attention had been paid to his throat. He had ulcerations on the epiglottis and on one vocal cord, besides infiltrations of the other cord, and interarytenoid spaces. By local applications these ulcerations soon healed, fortunately, and the patient could take his food without the slightest difficulty. Then I sent him back to the mountains. The infiltrations are there yet and he is hoarse, but that does not bother him. He has better chances for cure now than before.

Cases of tuberculosis of the upper air tract in many instances not only requires high altitudes, but often also a mild climate. This is another fact that apparently has been forgotten of late. A wind blowing at the rate of forty or more miles an hour is not good for many of our patients with involvement of the upper air passages. They have been compelled to return from some well-known sanatoria in the Catskills and Adirondacks and have done better in some of our southwestern states. It is remarkable how much cold and how much wind some patients can stand, but there is quite

a proportion who cannot stand this, and they do better elsewhere.

Robert Levy of Denver,* who has an exceptionally large experience in this field, attributes much therapeutic effect to the climate of Denver. In his statement others apparently agree with him, as for example, George L. Richards of Fall River, Solly of Colorado Springs and William Duffield of Phoenix, Arizona. I have reported my observations on the climate of the southwest some years ago (*N. Y. Med. Journal,* March 25 and April 9, 1898) and still hold the same views, believing that some persons will do well out west who have no chance of living in our New York climate.

(*d*) *Thallassotherapy.*—This is the treatment of patients by means of sea baths and sea air. The first will not be discussed here, since enough has been written on that subject in general. I would only add that tuberculosis in my experience is no contraindication to sea bathing. The same holds good for tuberculosis of the upper air tract, with but one exception, viz., when the salt water produces an irritating cough. In such an event it should not be allowed, but I must say that these cases are rare and that many paients take sea baths with good results when they are careful not to swallow too much water. Bathing and swimming have to be regulated as any other exercise on land. Too much of it may do harm, while if moderately taken and increased slowly it may do and has done a great deal of good. After the bath, the patient should react quickly and soon feel warm. If he is blue after coming out and a comfortable feeling does not set in promptly, sea baths should be prohibited or postponed until he is stronger.

The Treatment of Inhaling Sea Air. This is one part of our therapeutics that has been neglected in the United States until almost this day. When, years ago, I sent patients with tuberculosis in winter to Coney Island and neighboring places, one of our best laryngologists made fun of it. Nowadays, we have already advanced so far that we have a sanatorium for sick babies there, and it is doing good work.

And why not? I ask. This section, i. e., the southwest shore of Long Island, is to some extent protected against the cold north winds of the winter. If the sun is out with a south

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*Laryngoscope, p. 763, 1902; and Jour. Am. Med. Ass'n, p. 707, September 16, 1899.

wind, it is much warmer there than in the city, and the patient is able to obtain the great benefit of the sun, and absolutely pure sea air. Is that not doing a great deal to stimulate the organism to renewed vitality?

Another point is sea voyages. It is almost more than strange that we who are surrounded by water have not thought more of sea voyages as a means of restoring health. But it is perhaps that the nearest and most natural is overlooked. *Lucus a non lucendo.* The English have a large experience in that respect, and lately such a place has been proposed in Germany also by Nisser, v. Leyden, v. Bergman and Sobotta. I believe that such floating sanatoria would be of great benefit to our consumptives in this country, provided that vessels are built with all the conveniences and sanitary arrangements necessary for the care of such patients. A great deal of good could be done to quite a number of sufferers, provided they are selected with proper care. Such floating sanatoria could be used easily in the vicinity of New York during the summer months.

In conclusion, I would emphasize strongly the necessity of giving our tuberculous patients the benefit not only of medicinal and surgical, but also of climatic treatment. If after thorough trial a patient does not do well in one climate, he should be sent to another. But do not let us become pessimistic after having tried one specific kind of climate or treatment without success. Whatever be the method of treatment, the physician must always maintain a spirit of optimism which will be an inspiration to himself and the patient.

DISCUSSION.

Dr. James E. Logan, Kansas City, in opening the discussion, emphasized the fact that whether tuberculosis be general or be entirely of the upper air passages, it varies so much in different parts of the country that it is hard to give any specific outline of treatment, or any reliable statistics refereable to the results obtained. The cardinal principles to be observed under all conditions is that of maintenance of the general systemic condition. Results of treatment of laryngeal, aural and nasal complications depend largely on the condition of the patient. His experience in his own locality is that a large portion of the year is very acceptable, where the environment of the

patients are good. Dr. Bane had referred to the local application to the larynx of formalin, lactic acid, resorcin and idoform; Dr. Logan mentioned iodoform simply to condemn it, as it was so irritating to the trachea, producing a troublesome spasmodic cough. He sometimes used iodoform in pharyngeal ulcerations. Dr. Levy had brought out, in a very lucid manner, the surgical proceedings to be carried out in the treatment of laryngeal and pharyngeal conditions. The speaker wished to emphasize one very important point, viz., in all cases of tubercular otitis media there should be a careful examination made of the vault of the pharynx. Most patients suffering from tubercular inflammations of the upper air tract exhibit fragmentary and degenerate adenoid vegetations. The speaker has seen many such cases, and invariably removes these masses. This is especially a point of interest in all cases of aural complications.

He has seen many such cases recover from the aural disease by this operative interference. Dr. Levy mentions deep incisions into the structures involved—the experience of the speaker was not favorable to such procedure. He believed that the destructive process would be hastened if this plan of treatment be carried on in localities where tuberculous diseases were contracted. He has refrained from making these incisions, in the light of his own experience. He removes at all times all that he can of the epiglottis, whenever it is the cause of pain or prevents deglutition. Curetting of the tuberculous ulcer, followed by a 25 or 50 per cent solution of lactic acid was his favorite plan of treatment. The speaker's results have not been so flattering nor so happy that he would not prefer sending them to a beneficial climate. In the climate surrounding Kansas City it is impossible to put patients outdoors. A great benefit was to be derived from outdoor life, athletic exercises and a generous method of feeding.

Dr. W. C. Phillips, New York, said that every phase of this symposium was bound to be of great interest to all because it represents the most common of all serious affections of the upper air passages, and because of the extreme difficulty presented to the surgeon in every case. Regarding tubercular manifestations of the ear, he had no doubt that a considerable percentage of chronic purulent affections were tubercular; that it was difficult to make a diagnosis positively of tuberculosis

of the ear, as microscopic examinations of the discharges did not reveal the tubercle bacillus. Never could it be positively made except by pure culture. The same holds good as to the extension of the tubercular process in the accessory spaces connected with the tympanic cavity. There was no reason why the process should not extend, and the nature and character of the surface which was involved would encourage an extension to the cells of the mastoid process and the epitympanic space and on through to the brain. There were many cases, no doubt, of tubercular meningitis that have come through the ear. As to treatment in ear cases, the most radical surgical measures should be adopted, the results being invariably good, unless in far advanced general tuberculosis. The chief dangers were the impossibility of removing the last vestige of the process. In advanced general tuberculosis, soon to be fatal, it is wiser to leave the ears alone. As to the treatment of tubercular ulcers involving the larynx and pharynx, the results in the New York climate were so bad that surgical treatment was attempted with but little hope of success. He has never seen a case involving the vocal cords, the epiglottis, the false cords and the arytenoids recover. They are always, in the speaker's opinion, fatal. In one marked case of tuberculosis involving the base of the tongue without involvement of the epiglottis or larynx, but with the lungs involved, thorough curetting was employed on several occasions, together with all the usual medicinal applications, yet the case went steadily on to fatal termination. Extreme care should be used in advising a patient to go away from home with a false hope of trying to recover from a fatal tuberculosis.

Dr. H. Bert Ellis, Los Angeles, was much impressed with the enthusiasm of the different writers. He thought that if the diagnosis is made early, the local, surgical or climatic treatment would give favorable results. If serious involvement of the larynx or pharynx is present, little hope should be held out. He had the same experience with incision as did Dr. Logan; it made the patient worse. When the speaker now sees a case of serious tuberculosis of the larynx with considerable infiltration, he feels tolerably certain the patient will die within six month to a year. He depends entirely on fresh air out of doors, stuffs the patient with eggs and milk, and gives up all local treatment. He has two patients at the

present time where there was almost total destruction of the vocal cords, and the false cords were much infiltrated, the epiglottis three times its normal size, and the patients were scarcely able to breathe; these two patients were sent to the desert, and after being there a year, the ulcers had healed. The patients are practically well as long as they remain in the desert. Operative interference on the pharynx and larynx, in the speaker's experience, usually makes the conditions worse; however, to relieve the pain, portions of the new growth can be removed with advantage.

Dr. H. W. Loeb, St. Louis, said that operative treatment in these conditions appealed to him from a different standpoint from what it had years ago. He then did some considerable operating with some improvement and eventual death, with slightly increased length of life and slight decrease in the severity of the symptoms. He then took the position that operative intervention was without avail. One patient was treated without operation and he lived seven years and finally died of tuberculosis of the lungs. Two years ago, when he visited Denver, he changed his mind in regard to the results of operation, because he saw laryngeal tuberculosis in which operations had been performed and good results had been obtained. They were sufficient to convince him that a tubercular patient had a better chance by being sent to a proper climate and to a competent laryngologist. He thought we should be more optimistic and any improvement should be accepted with satisfaction. He had found orthoform quite irritating; he now uses anesthesin.

Dr. E. M. Holmes, Boston, reported a case ten years ago of a man who had traveled all over the west and then came east. He had extensive laryngeal ulceration and looked as though he would be unable to live very much longer. His physician had him on the roof of a piazza, and he obtained some relief from lactic acid. That man is now alive and carrying on business actively in Brockton, Mass.

Dr. W. S. Bryant, New York, said that otitis of tubercular origin in his experience and that of others results nicely after surgical intervention, so much so that it seemed much earlier indicated in tuberculosis. Healing seemed to be quite as ready as in those conditions which have no tubercular symp-

toms. The question of diagnosis he thought a rather delicate one, because of the inability to obtain the bacilli by microscopic test, but the clinical course of these cases, with destruction of tissue and low grade inflammation, was diagnostic.

Dr. Kaspar Pischel, San Francisco, drew the attention of the members to a paper soon to appear in the *California State Medical Journal* by Dr. Max Rothschild as to intravenous injections of Koch's tuberculin. The paper was to have been read at the recent meeting of the State Medical Society which was interrupted by fire. It is a preliminary report of about twenty-five cases with some marvelous results. Dr. Pischel mentioned one case of tuberculosis of the larynx in which the ulcers healed so quickly under the intravenous injections and local treatment with lactic acid that it could hardly be attributed to the local treatment alone.

Dr. Robert Levy, Denver, in closing the discussion, said there were some important points to consider. During the past few years he had arrived at a uniform basis as regards surgical treatment in these cases. He does not believe in advocating enthusiastically all surgical measures, but he believes there is a rational middle ground for this treatment. It was unquestionably true, he knew, that there were many cases of spontaneous cures of laryngeal tuberculosis; the literature was full of them, and they were heard of at every meeting. That the general or climatic, or any one treatment was responsible for this, one cannot affirm. It was a question of adoption of methods of treatment in the hope that because it was known that spontaneous cures occurred, that treatment would assist in this cure. The relief of the symptoms alone is sufficient to warrant treatment, for life may be prolonged by adding to the patient's comfort. He thought also that as to climate it was altogether a question of altitude. He believed, as Weber had pointed out, it was a question of fresh and pure air. As to the ear, he has observed local conditions improve while the general condition has remained the same or grown worse, and, per contra, suppurative processes have often begun in the ear when the patients were comparatively well. As to the diagnosis of tuberculous ears by bacterial examination, it was pointed out by Wingrave that the difficulty in discovering the bacillus was often due to the difficulty of procuring the specimen from the proper place.

XLII.

ASPIRATION OF THE TYMPANIC CAVITY IN OTITIS MEDIA.

By Percy Fridenberg, M. D.,
NEW YORK.

A truism of metaphysics compares human progress to a spiral which at certain points returns upon itself before again advancing, rather than to a straight line of uninterrupted advance. The last decade has seen notable improvement in the technique of aural surgery, in the recognition and management of the otitic cerebral and vascular complications, and in the prophylactic therapy of the nose and naso-pharynx. Of late, we seem to have come to an end of innovations and explorations and to be devoting more attention to some well-known parts of the domain of otology with a view of possible improvement in method. In this connection I may mention the blood clot dressing in the attempt to obtain early closure of the mastoid wound, and the treatment of middle ear and mastoid inflammation by local hyperemia, the congestion treatment of Bier. There is still some doubt as to the former procedure being based on sound principles of surgery and quite decided doubt as to its practicability. The first reports in regard to Bier's treatment were uniformly favorable, and those from the surgical clinic at Bonn, as might have been expected, quite enthusiastic. A more general trial of the congestion-method in other institutions and countries resulted in a less unanimous verdict, and now we are beginning to hear of the failures and dangers of the procedure. Whatever the advantages of constriction and hyperemia may be in inflammatory disease of the limbs and joints, or of the skin, I think that it is a very dangerous and objectionable form of treatment for otitic disease. The prime requisite it seems to me, is free drainage, especially in acute cases, and any interference with this process is intrinsically and radically wrong. In acute otitis media we perform paracentesis as soon as we have evidence of an exudative inflammation in the middle ear, and encourage the discharge of infectious material by gravity, heat, irrigation, in fact, by every means in our power. This subject is at least as important in the end as sinus thrombosis and brain abscess, for rational treatment of middle ear disease,

and incidentally, let me repeat, of naso-phayngeal catarrh and hypertrophy, represents the stitch in time which saves, not only stitches nine, but life as well.

There is a perfect chain from adenoids to acute otitis, to mastoiditis, to thrombosis, labyrinthine suppuration, meningitis or abscess, and while I do not wish to claim that the intracranial complications are preventable, I do maintain that the chain can be broken, and is best broken at its weakest point. This is the treatment of the naso-pharynx, and if this point is past, and if in a specific case we are in the presence of a florid otitis, we can break the chain at its second link as easily by free paracentesis as free drainage.

The latter process is immeasurably assisted by aspiration of the tympanic cavity as well as physiological. The factors are mechanical, as the first effect of suction is to cause free bleeding from the mucosa of the middle ear, thinning the inflammatory exudate and thus facilitating its removal by gravity, syringing, or aspiration. Local depletion is a secondary result and this, as is well known, has a most favorable effect on pain and inflammation, especially where, as in these cases, the pain is due to tension and pressure.

It is still an open question whether fresh serum has a marked bactericidal action, but there can be no doubt that it is much less septic than the fluid in the inflamed middle ear, so that dilution with fresh blood can be only beneficial. The effect of aspiration on the cut in the drum is to cause it to gape widely or to open if occluded by blood clot. This is an obvious advantage and one of practical value.

No special apparatus is needed. The method is ready at any moment. Any glass bulb will answer which will plug the meatus, does not have a sharp tip to cause possible injury, is wide enough to be easily cleansed out, and will stand boiling. Its diagnostic use enables us to get a large amount of fluid matter from the middle ear which is received directly into a sterile receptacle, without contamination, giving ideal matter for bacteriologic examination, blood count, or Widal's test, which may be of great importance for a differential diagnosis in otitic complications or suspected general disease. It has suggested itself that the suction acts very much like a leech-bite or wet-cup, abstracting blood, and tiring out the walls of the small vessels by continued negative atmospheric pressure (aspiration) and so producing a depletion in the

congested area together with a reactive hyperemia at the site of the hypothetic leech-bite, i. e., the incision, and the mucosa of the middle ear. I believe this is a very much more exact way of using the principle of local blood abstraction than by putting a leech on the tragus or the mastoid. It seems to me to be in line with the method of congestive hyperemia of Bier, besides being free from a number of objectionable features connected with the application of a constricting bandage around the neck which has to remain for 24 hours or more, and is very irksome if not intolerable. The degree of hyperemia whether red or blue has to be carefully watched and the technique has to be learned by experience.

While drainage can be assisted it can also be opposed and any methods which interfere with it can not be too strongly condemned. Among them I will mention plugging the external canal with a so-called drain, putting ice bags on the ear or mastoid, producing hyperemia in the middle ear by any method, and finally, Politzerizing or catheterizing in an attempt to blow secretion out through the drum opening. The danger is obvious and real, and no theoretic considerations should tempt us to overlook it. It has been claimed that the mucosa of the aditus is so swollen that it blocks off the antrum from the middle ear so that pus and germs could not be blown into the accessory cavities of the middle ear. I need hardly lay stress on the visionary quality of this theoretic safeguard. We know that in many cases, in spite of this protection, germs or pus do get into the mastoid cells, even where there have been no mechanical procedures tending to drive them there, so that we would naturally avoid any procedure which would have this effect.

XLIII.

THE MORPHOLOGY AND EMBRYOLOGY OF THE NASAL FOSSAE OF VERTEBRATES.

By Leon Dieulafé,

Translated by Hanau W. Loeb.

(*Continued from the June Annals.*)

BIRDS.

Numerous works on the development of the olfactory apparatus of birds have been published, but they deal with the chicken for the most part.

Historical.—Koelliker (1860) observed the appearance of the olfactory fossettes in the anterior and lateral portion of the cranium of a chicken, at the end of the third day of incubation. They are situated below the eyes. On the fourth day, they are larger and deeper. A groove is formed, the nasal groove, which, elongating the supramaxillary bud, connects the fossette with the buccal cavity. The evaginations forming the olfactory bulbs are added to mucous portion formed by the ectodermic depression.

The two nasal grooves are shortened by the fusion of the superior maxillary and frontal buds. The fossette is limited throughout its periphery, and the nasal groove is transformed into a canal which ends in the buccal cavity by forming the internal nasal furrow (primitive palatine cleft of Dursy). The formation of the palate is concerned in the formation of the respiratory portion of the nasal cavity, the most elevated portion of the primitive buccal cavity. The boundaries of the olfactory organ, the frontal bud and the external nasal buds contribute in the formation of the face at the level of the anterior extremity of the cranium, particularly the ethmoidal and nasal portions.

Parker (1869), who studied the development of the cranium in Gallus domesticus, occupied himself at length with the evolution of the olfactory cavity. At the fourth day of incubation, the nasal cavity is still a simple slit; the nasal cavity is limited

by expansions of the trabeculae which constitute its alieth-moidal and alispetal portions; it is a formation continuous with the primordial cranium as the auditory capsule.

On the fifth and seventh day, the canal may be seen uniting the buccal cavity with the nasal labyrinth, between the palate bone and the prefrontal lamina.

Föster and Balfour (1877) found depressions of the epiblast during the third day in the chicken. The olfactory fossettes originate in the same way as the crystaline lens and the labyrinth of the ear, but with this difference, that they are never closed.

Milnes Marshall (1879) finds that the first stages of development in the chicken are analogous to those of the selachians; the olfactory fossette appears at the 54-hour stage in the form of a thickening of the epiblast. With Dohrn, he admits the resemblance of this outline to a branchial cleft, i. e., the first cleft.

Born (1879) gives a lengthy description which coincides with the principal points of that of Koelliker. Fusion of the superior maxillary and external nasal buds are effected as in reptiles. The external nasal bud has a round prolongation, which is the outline of the primitive nasal or middle turbinal. This appears before the separation of the external opening of the choana, which is effected at the end of the fifth day. A protuberance, which is the first manifestation of the beak, lies in the median portion of the face, between the swollen borders of the nasal canal. After the fusion of the different buds, the elevation of the borders of the nasal cavity appears and at the same time the beak gains in length; in this way is constituted the entrance of the canal or vestibule. The entire lateral wall presents a hemispherical swelling which indicates the vestibular turbinal.

At the eighth day of incubation, the nasal gland appears in the form of a solid invagination of epithelium of the internal wall of the vestibule. This gland can not be homologized with the organ of Jacobson, which, on the other hand, must be entirely deficient.

Mathias Duval (1889), in his atlas of embryology of the chicken, indicates the appearance of the olfactory outline as an ectodermic thickening at the 52nd hour of incubation.

Putelli (1888) observes that, at the level of the ectodermic thickening which forms the olfactory outline of the chicken, the cells which are flattened on the borders of this zone become

elevated in measure as they advance towards the center. When the olfactory groove is well formed, the larger portion of the wall is covered with high cylindrical cells. Then when the olfactory cavity grows, there are distinguished on its walls an olfactory zone in which the epithelium is very elevated, and a respiratory zone in which the cells are cubical.

A new form of cells appears in embryos six or seven days old; these recall those which Kaufmann and Lustig describe as transitional forms; they are scattered among the high cylindrical cells.

At the seventh to the eighth day, the cylindrical cells have a finely granular protoplasm, which is more slightly colored by carmine than is the nucleus. The cell is prolonged by an extremity more or less conical towards the mesodermic layer, without having the long filiform extremity with which these same cells are provided in the adult mucosa. The transitional forms are colored more intensely; they are situated as sunken rods between the cylindrical cells.

Preobraschensky (1892) gives us another histogenetic study. At the beginning, the olfactory organ of the chicken has a single layer of cylindrical cells; when the primitive olfactory fossette enlarges, the bottom is covered with an elevated epithelium, but the ventral region, which utilizes for its extension the growing neighboring zones of ectoderm, presents an epithelial investment exactly similar to the ectoderm. This is the respiratory region. A thickening, which is the beginning of a large ganglion, is seen anterior to the anterior cerebral vesicle, in an embryo of five days and three hours.

The two regions, olfactory and respiratory, are entirely different; in the respiratory region there are two cellular layers, of which the deep is cubical and the superficial is flat. The filaments of the olfactory nerve may be seen. The lateral wall already shows the turbinals, and the superior turbinal alone appertains to the olfactory region.

On the eighth day, the relation of the olfactory nerve to the olfactory epithelium is very clear and the nervous network is quite visible.

Ganin (1890) considers as the organ of Jacobson in birds an embryonal outline which in reality corresponds to the canal of the lateral nasal gland.

Peter (1902-3) reviews the works of Koelliker and Born and draws conclusions from publications which treat incidentally of

the nasal organs. For example, Van Wijhe indicates the first outline in the embryo of a duck having 23 primordial segments, and Abraham in a specimen of Melopsittacus undulatus provided with 25 to 26 segments.

Franz Cohn (1902) studied the development of the olfactory organ in the chicken. It appears at the stage of 23 to 24 primordial segments at the 72nd hour of incubation; it is a flat lamina formed by thick epithelium without any trace of depression. It is first placed laterally on the head and is then more and more displaced towards the ventral surface. The increase of the olfactory groove is effected by active proliferation of the sensory epithelium and not by passive displacement.

In embryos, with a head 5.6 mm. long, the median wall of the olfactory fossa close to the external orifice shows a depression covered with sensory epithelium which corresponds to the organ of Jacobson, but which is of very short duration.

Two turbinals, the one primary or middle, the other secondary or superior, are formed in the region of the nasal cavity covered by sensory epithelium. The vestibular turbinal has its origin in the vestibule, from the wall covered with indifferent epithelium. Cohn, basing his observations on the investigations of Peter, which we shall report later, considers the superior turbinal of birds as homologous with the nasoturbinal of mammals and not the ethmo-turbinal.

Beecker (1902) has observed in Anas domestica and Gallus domesticus that the nasal canal is divided into a vestibule and a turbinal region. The vestibule is very long and narrowed by a dorsal fold, the vestibular turbinal. The choanal canal is not greatly bent. The middle turbinal is homologous with the true turbinal of reptiles. There is no outline of the organ of Jacobson.

Description of Stages. Undulated Parrot. 5 *mm. total length* (5th day of incubation; Fig. 40).—The embryo of this stage, seen in profile with the aid of a binocular microscope, shows the olfactory vesicle under the form of an ectodermic depression largely opened externally and prolonged downward by a groove. This groove is placed below and in front of the eye upon the lateral surface of the head. In transverse sections, the outline is placed at the union of the lateral with the ventral surfaces; it is constituted by a thickening of the ectoderm, which buds and forms a cellular cord, 30 mikra long, separated

from the external layer. For a distance of 225 mikra, the ectodermic thickening is depressed into a groove, which has a maximum depth of 71 mikra and a transverse extent of 142 mikra (Fig. 40).

The olfactory zone behind the groove is a simple thickening of the ectoderm; the total length of the outline is 365 mikra. Its width at the level of the groove is 263 mikra, and in the posterior region, where the thickening is not depressed, 285 mikra.

The cells which constitute the olfactory outline are round, separated from one another, and arranged in several layers without forming regular coats. The surrounding ectoderm

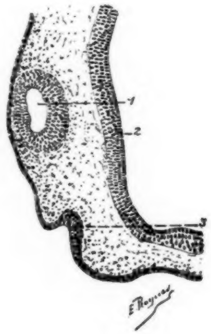

Fig. 40—X 40. Parrot, 5 mm. in total length (fifth day of incubation; transverse section, right side). 1. Eye; 2. Central nervous system; 3. Olfactory outline.

comprises two layers of small round cells. At the stages of 5.2 mm., 5.5 mm., and 6 mm., there is no change in relations or form, except that the depth of the fossette is increased.

6.5 *Millimeters.*—The mesoderm which surrounds the groove is thickened and forms two buds, which approach one another and fuse at a certain place; this is the zone in which the vesicle is closed in the sections. The thickness of the wall of the olfactory cavity increases from the border towards the bottom.

8.5 *Millimeters.*—Of the two buds, the internal is quite long vertically and the zone of union with the external bud is more extended. The olfactory vesicle changes in form, the external wall is convex and the internal wall is concave. The two cavi-

ties approach one another but remain separated by a large zone of mesenchyme, which is to form the nasal septum.

Behind the zone of fusion of the two buds, the cavity opens downwards. There exists, below the septum and between the internal buds, a large space which receives the opening of the two nasal cavities and which is lost below in the buccal space.

The cells which border the fossette begin to assume an elongated form.

9 *Millimeters* (7th day).—The olfactory cavity is a deep depression directed from the ventral surface of the ectoderm towards the infero-external angle of the neural tube. Its bottom is dilated into a vesicle, its ventral segment is narrow and forms a canal of entrance. The epithelium of the canalicular region is composed of large round cells; in the vesicular region it thickens gradually towards the bottom and presents a superficial layer of very long cylindrical cells, of which the large central extremity has a depressed border, while the peripheral extremity sinks between the deep layers of round cells. The buds which limit laterally the narrow region of the cavity are fused posteriorly and form thus a floor which closes the cavity.

11 *Millimeters* (8th day).—The external wall of the olfactory vesicle is no longer simply convex; it presents a large, round, pedunculated ridge directed internally and inferiorly. The nasal lumen sends out a sort of fissure which separates this ridge from the external wall, making a turbinal. The epithelium which covers it is thin below; the external, superior and internal walls have a very thick investment.

21 *Millimeters* (10th day).—The nasal cavity proper is preceded by a region occupied by an epithelial mass, in which the lumen is entirely absent; this is the vestibular region which has a length of 380 mikra.

In the anterior region of the cavity, the superior wall is the site of a voluminous ridge which sinks into the lumen and gives to it, in frontal section, the form of a "U" opened above. In going from before backwards, the base of this ridge is seen contracted, becoming a true pedicle, which is displaced towards the external surface, its line of insertion being oblique from before backwards and from above downwards.

This is the middle turbinal, which has taken on a great extension. Its insertion is 250 mikra on the superior wall and 280 on the external. Its pedicle has a thickness of 185 mikra anteriorly and of 92 towards the middle portion.

The cavity enlarges vertically from before backwards, and at a distance of 650 mikra from the anterior extremity of the vestibular region it opens below into the buccal cavity. The choana, which has a width of 38 mikra, and a length of 240, does not end directly in the buccal cavity. It is joined with that of the opposite side in a canal limited by the palatal buds, with an average width of 71 mikra and a height of 357.

The olfactory epithelium exists only in the posterior portion

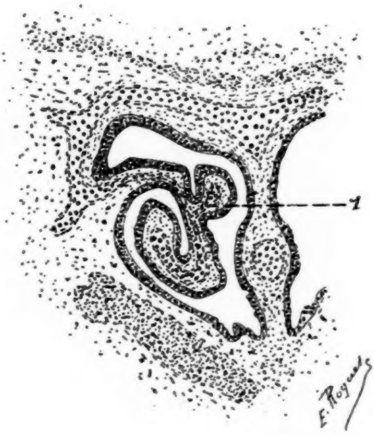

Fig. 41—X 34.3. Parrot, 23 mm. long (17th day of incubation; transverse section, right side). 1. Middle turbinal showing two coiled laminae.

of the cavity and does not cover the turbinals. A cartilaginous lamina, quite thick, lies all around the nasal cavity, especially at the level of the external wall, the roof and the septum.

23 *Millimeters* (17th day; Fig. 41 and 42).—The middle turbinal at the level of its insertion on the roof of the cavity has a smaller pedicle than in its preceding stage (100 mikra); its insertion has the same obliquity from before backwards and from above downward. It has two laminated coils, one on each side of the pedicle; the one directed at first internally becomes

superior a little farther along; the other is external, then inferior. Anteriorly the extent of each lamina, measured at the point of departure of the axis from the pedicle, is 357 mikra. The inferior lamina is larger than the superior at the level of the insertion of the turbinal on the external wall; towards the middle portion the inferior is 335 mikra high, while the superior (Fig. 41) is 264. A cartilaginous lamina penetrates into the turbinal and bifurcates at the apex of the pedicle in order to follow each coil (Fig. 41). The inferior lamina is single (Fig. 42) towards the posterior extremity of the turbinal. Behind the middle turbinal and its pedicle, the external wall is the site of another ridge slightly extended antero-posteriorly with a height of 250 mikra in its middle portion, while anteriorly and posteriorly it is only a simple bulging of the wall (Fig. 42).

It is covered with thick epithelium, having the characteristic of that which covers the superior region of the nasal cavity, i. e., of a sensory nature; it forms the superior turbinal.

The floor of the nasal cavity, almost at the level of the union of its anterior with the middle third, sends out a small diverticulum to the interior of the septum, directed downward and inward; its antero-posterior extent is slight; it is a diverticulum in the form of a groove, which represents perhaps a rudimentary organ of Jacobson. We have found no other trace of this organ.

DUCK. *4th day of incubation.*—The olfactory outline, as in the parrot, is represented by a thickening of the ectoderm, which is depressed into a fossette, and which is formed of round cells without differentiation from those of the superficial layer.

7th day.—The fossette is increased, is deeper and is opened directly downward. The thickness of the epithelium increases from the border of the groove towards the bottom, where it is formed of three of four layers of round cells.

10th day.—The anterior portion of the nasal organ is formed by a compact cellular mass which borders a depressed epithelial tract. The lumen which begins to appear is triangular in transverse section, with an apex inferior and two other angles in the form of deep fissures, one of which is directed externally and upward, the other vertically upward. A bud, which is the anterior extremity of the middle turbinal, is found between

these two fissures. This turbinal is inserted obliquely from before backwards and from above downwards. It has only one coil directed downward. One millimeter from its anterior extremity, the floor of the nasal cavity is united with the buccal epithelium by a vertical tract, behind which is the choanal fissure. The choana is a large cleft of 414 mikra, which ends directly in the buccal cavity. In measure as the insertion of the middle turbinal descends on the lateral wall the superior

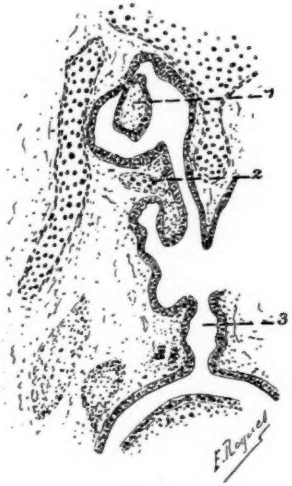

Fig. 42—X 34.3. Parrot, 23 mm. long (transverse section posterior to that of fig. 41, showing the middle turbinal, the superior turbinal and the palatal fissure common to the two nasal cavities, right side). 1. Superior turbinal; 2. Middle turbinal, having at this place only one coil; 3. Palatal fissure.

portion is enlarged. It forms a nasal roof, which is covered with sensory epithelium like the adjacent portions of the external and internal walls. In this region of the nasal cavities there is developed another turbinal placed above the middle turbinal (Fig. 43), a long ridge of 700 mikra. It is slightly internal wall. This turbinal is covered with sensory epithelium in its entire extent. The cartilaginous skeleton lies at the

level of the septum and of the external and superior walls; it sends out a cartilaginous axis to the middle turbinal and is corrugated at the level of the base of the superior turbinal. elevated anteriorly and posteriorly, having a height of 392 mikra in its middle portion; posteriorly the pedicle disappears

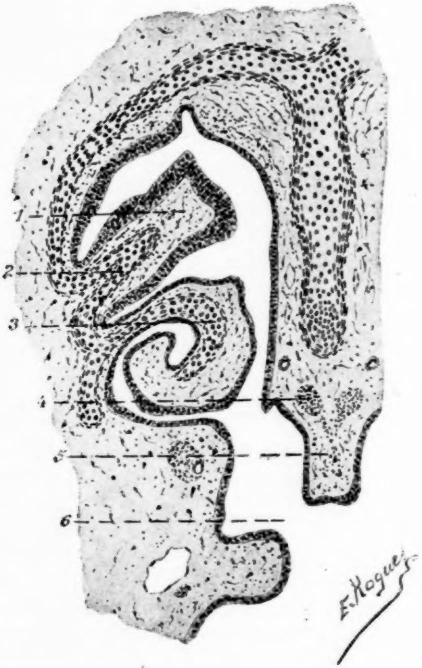

Fig. 43—X 34.3. Duck at 12th day of incubation (transverse section, right side). 1. Superior turbinal; 2. Fold of cartilaginous wall penetrating the superior turbinal in place of a cartilaginous axis; 3. Cartilaginous axis of middle turbinal; 4. Vestige of the organ of Jacobson; 5. Septum; 6. Choana.

and the base of insertion occupies the entire height of the

12th day (Fig. 43).—The general arrangement of the cavity is similar to that of the preceding stage; the turbinals are more developed, but occupy the same respective positions. The choanal clefts on each side of the septum attain a common

junction in communication with the buccal cavity (Fig. 43). The anterior portion of the nasal cavity is enlarged transversely by a hollowing out of the epithelial mass, which in common with the epithelium of the lateral wall is formed of round cells. In measure as we approach the zone in which the lumen penetrates into this mass, we see the cells of the center becoming larger and clearer, the nucleus smaller and the protoplasm losing its granular character. The resorption of these cells gives rise to the nasal lumen.

The manner in which the cartilaginous skeleton is arranged at the level of the turbinal is interesting. While the middle turbinal is penetrated by a cartilaginous lamina, which forms the axis of the ridge by being located in the center of the mesenchyme, the cartilaginous lamina of the external wall in the interior of the superior turbinal is depressed, forming a fold (Fig. 43). Two dense cellular masses, composed of small, round, sunken cells, lie towards the inferior extremity of the septum. They are placed one on each side of the median line, below the free border of the septum (Fig. 43), and they thus occupy the position of the organ of Jacobson of Mammalia, but there is no other fact which would justify us to accord to it this value.

Beginning of the Olfactory Outline.—According to our investigations on the undulated parrot (Mellopsittacus undulatus) and the common duck, the olfactory outline is a thickening of the ectoderm, which is depressed into a fossette in its central portion. The ectoderm in the undulated parrot of 5 mm. (5th day of incubation) is composed of two layers of round cells. All the cells at the level of the olfactory thickening, which we have observed at this stage, have this form. The most superficial cells acquire a cylindrical form in the bottom of the olfactory fossette, in the 9 mm. stage (7th day of incubation).

Putelli (1888) observed these cylindrical cells from the beginning of the formation of the olfactory fossette. It is true that he does not indicate the exact stage in which these observations begin. Preobraschensky (1876) also finds the differentiation of the cylindrical cells effected at the beginning of the olfactory thickening.

Born (1879) states that in the chicken the olfactory depression, which appears on the 3rd day, is covered with sensory

epithelium, which is continuous on its borders with the epidermis, which has two layers.

Cohn (1902) shows the active part taken by the cells of the olfactory thickening in increasing the olfactory fossette, in opposition to the passive role which this region enjoys in its increase, according to Born, Minot, Goette and Preobraschensky. He found the olfactory field placed at first on the lateral walls of the head, then more and more displaced to the ventral region, and finally entirely ventral, even before the depression of the olfactory fossette acquires an appreciable extension.

Koelliker, Born and Cohn indicate the 72nd hour as the beginning in the chicken; that is to say, the end of the 3rd day of incubation. This is, according to Cohn, the stage of 23 to 24 primordial segments.

Mathias Duval represents the olfactory thickening in a chicken embryo of 52 hours, and Keibel in an embryo of 48 hours. Van Wijhe finds the first beginning in a duck with 23 primordial segments and Abraham in the undulated parrot with 25 to 26 segments. We found it in the duck in the course of the fourth day and in the undulated parrot of 5 mm. (fifth day of incubation).

Evolution of the Nasal Cavity.—Koelliker (1860) has well shown how the masses which limit laterally the nasal fossette by fusion limit the external nasal orifice and separate it from the internal nasal orifice, which is the opening in the buccal cavity of the nasal groove transformed into a closed canal.

Born (1879) establishes the appearance of the outline of the middle turbinal on the lateral wall (external nasal bud) before the supervention of the separation of the external opening and the choana. This separation is effected towards the end of the fifth day in the chicken by fusion of the inferior extremity of the external nasal bud with the superior extremity of the superior maxillary bud and with the internal nasal bud. This zone of fusion forms the roof of the nasal cavity, where it appears in the form of a closed vesicle, in frontal sections.

Behind the bridge thus formed, the nasal cavity communicates with the buccal cavity by a cleft situated in a horizontal plane; this is the choana, which definitely preserves this disposition. Born has found the palatal lamina arising from the superior maxillary buds, but they are not united with one

another and the palate remains cleft. We see between the maxillary buds a space which communicates above with the two nasal cavities, in which the free extremity of the septum makes a ridge, and which, on the other hand, opens largely into the buccal cavity.

Anteriorly, the nasal and maxillary buds enter into the constitution of the face; however, they take on an elongated form, the length of which varies infinitely, depending on the species of the bird, the buds increasing antero-posteriorly.

The nasal cavity increases between them in the same direction, and thus an anterior vestibular region is formed. The buds being greatly separated from one another, there is no cavity at the beginning of the formation of the vestibule and the external and internal epithelial walls are in contact.

Most of the time, the external wall is strongly convex and presents the outline of a ridge which is to become the vestibular turbinal.

This region forms the epithelial pad in which the vestibular lumen is secondarily hollowed. The formation of the vestibule carries the displacement anterior to the external orifice.

The nasal cavity and the vestibule are complicated by the formation of the turbinals. The first turbinal appears disposed as that of the reptiles; it takes its origin anteriorly on the superior wall or the most elevated portion of the external wall, and its line of insertion is directed obliquely downward and backward in such a manner as to acquire a lower and lower position on the external wall.

The posterior region of the cavity contains another turbinal, the superior, arising from the external wall above the insertion of the middle turbinal. Only the superior turbinal is developed in the region covered by sensory epithelium; it has an investment of this sort. The middle turbinal is distinctly placed in the respiratory region towards the anterior extremity, where it appertains, so to speak, to the nasal roof. The olfactory epithelium does not exist at its level.

Born and Cohn consider that the two turbinals originate in the olfactory region. As to the vestibular turbinal, it is a formation belonging to a zone covered with an indifferent epithelium, as Born and Cohn established before us. The process of fissuration, the importance of which we have noted in reptiles, enjoys here a role of the same value.

We see the narrow diverticula of the nasal lumen sinking

into the thickness of the walls, thereby depressing the epithelium. A ridge is circumscribed between two fissures of this kind, enclosing a mass of mesenchyme, whose increase has an active role in the development of the turbinal.

When the turbinal rolls up, one of these fissures continues, penetrates into the mass of mesenchyme, cuts it more or less and detaches a part which has a twisted appearance.

The double coil of the middle turbinal in the parrot is remarkable; in this case the two bordering fissures have a symmetrical evolution and hollowness of the two lamina results. This arrangement is found only in certain mammals (ruminants, pachyderms). The arrangement of the cartilaginous skeleton in the interior of the turbinal is therefore of some interest; the middle turbinal has an axial lamella, arising from the external cartilaginous wall, which penetrates into the mesenchyme at the free border of the ridge, presenting a parallel coil.

The cartilaginous lamina, which penetrates into the superior turbinal, is formed by a fold of cartilage of the external wall; there is no pedunculated portion. From the fact that this turbinal has no pedicle, it is not a true turbinal, according to Gegenbaur, but a pseudo-choncha, like that of the crocodile.

The middle turbinal, according to Gegenbaur (1873), corresponds to the maxillo-turbinal or inferior turbinal of mammals.

This comparison rests especially on the position of the orifice of the lachrymal canal below the middle turbinal of birds as below the inferior turbinal of mammals. The vestibular turbinal being a formation peculiar to birds, not present in all species, there is no place to look for its homologue.

The superior turbinal has been compared to the ethmoturbinal of mammals. This is not the opinion of Peter, who shows that the ethmo-turbinal is formed by fissuration of the median nasal wall, while the naso-turbinal and the maxilloturbinal belong to the external wall. Cohn has clearly observed in the chicken that the superior turbinal is a formation of the external wall, and is homologized with the naso-turbinal and not the ethmo-turbinal.

According to our investigations on the parrot and duck, the superior turbinal is formed in the posterior extremity of the nasal cavity, and besides is covered with olfactory epithelium.

It should therefore correspond to the olfactory turbinal or ethmo-turbinal.

With reference to the absence of the organ of Jacobson, we gave, in the Chapter on Morphology, the opinions of Ganin and Mihalkovics, who admit its existence in a rudimentary state. Cohn noted a depression covered with sensory epithelium on the median wall of the olfactory fossette of the embryo of a chicken, with a head 5.6 mm. in length. The cells of this epithelium are cylindrical with a basal nucleus and are twice as high as those of the indifferent epithelium. This depression which is found in embryos, with a head-length of 5.9 mm., is not observed in the succeeding stages.

We found, in the parrot of 23 mm. (17th day), and in the duck of twelve days, some formations which might represent the vestiges of an organ of Jacobson. We observed a diverticulum of the nasal floor sinking into the septum in the parrot, and a cord of round cells in the duck placed below the septal cartilage.

Admitting, as we have, that the palatal fissure permits the olfactory epithelium to have the function of sensory control of the buccal contents, we explain the absence of the organ of Jacobson in the adults, but it is difficult to affirm that it produces no anlage, being rudimentary itself.

Born and Cohn noted an evagination of the lumen, between the middle and superior turbinals, which was directed backward, forming the beginning of the sinus orbitalis.

Born found, on the eighth day of incubation, the beginning of the lateral nasal gland constituted by a solid epithelial evagination of the vestibular wall, close to its posterior extremity. The glandular canals are provided with a lumen on the fourteenth day.

MAMMALS.

HISTORICAL. *I. Nasal Cavity.*—Meckel (1812) considered the buccal and nasal cavities as originally forming only one spacious cavity, which later is separated into two distinct compartments. This view had many partisans, among whom the embryologists Caste and Erdl may be cited. It survived a long time, in spite of the investigations of Von Baer, Rathke, Huschke, Reichert, Bischoff and Remak, who observed that from the beginning there existed two perfectly separated cavities. Von Baer named them the olfactory fossettes.

Rathke was the first to observe these fossettes in mammals, Bischoff, in the dog.

Koelliker (1882) described them in man and found them first in an embryo of four weeks. This author studied their formation in the rabbit; they are preceded by a considerable thickening of the ectoderm. In the continuation of the evolution, he describes the closure of the nasal fossa by coalescence of the nasal and superior maxillary buds, as in the chicken. The formation of the palate subdivides the buccal cavity into two portions: the superior or respiratory, which is the nasopharyngeal canal, and the inferior or digestive, which is the real buccal cavity.

Dursy (1869) observed the olfactory fossette forming in the human embryo on the lateral wall of the head in front of the eye. The border is increased by a cushion, which greatly deepens the fossette. A depression on the internal wall forms the organ of Jacobson.

The external and internal nasal buds, as well as the superior maxillary bud, limit the fossette and fuse together, closing it below. Behind this zone of union a cleft is seen, the primitive palatal cleft.

The evolution of the different buds of the face and the formation of the palate were extensively studied by this writer.

His gives the name of nasal field to the ectodermic thickening which forms in front of the olfactory depression. His reconstructions of the human embryo show with great distinctness the fusion of the nasal and maxillary buds and the formation of the palatal vault.

Rémy (1878) showed the ectodermic origin of the pituitary membrane; he insists especially on the histogenesis of this

mucosa and the differentiation of the epithedial cells. The glands appear in a human embryo 18 cm. in length. The turbinals are well developed at this stage. The maxillary sinuses appear towards the fourth month of fetal life, a little before the ethmoidal sinuses are formed. The sphenoid sinus appears towards the end of the first year after birth, and the frontal sinus from the seventh to the eighth year.

Hertwig describes the formation of the external and internal nasal orifices, the palatal vault, the turbinals and the sinuses, according to the His casts and sections of the embroyo of a pig.

Legal (1883) follows the evolution of the nasal cavity and the organ of Jacobson in embryos of the pig. He is concerned more especially with the formation of the turbinals. An epithelial bud lies external to the inferior primitive nasal canal; it indicates the separation between the superior maxillary and external nasal buds and forms the lower boundary of a convex swelling of the external nasal wall, which is the beginning of the inferior or primary turbinal.

Another elevation which is separated from this by a groove is the beginning of the secondary olfactory turbinal.

Laguesse (1885), in a thesis on the development of the respiratory epithelium, follows the evolution of the ectodermic cells which cover the nasal fossae. In a sheep embryo of 1.7 cm. (in a straight line), about five weeks old, the epithelium of the olfactory cavities had not lost its embryonic characteristics. Its thickness, quite uniform, is about 45 mikra; it is formed of small, finely granular cells, staining uniformly. There can already be seen some sparse, spherical or polyhedral, vesicular cells with a membrane of distinct thickness, a clearer, slightly granular cell-body and a round nucleus. In embryos of 5 cm., the epithelium is slightly increased in thickness, but the majority of the cells are subjected to a transformation, which consists in an augmentation of the transparency of the cell-body. The process is generalized throughout the height of the epithelium. The cells are disposed irregularly in three layers; it is an embryonic stratified epithelium in process of evolution towards the cylindrical stratified form. The nucleus is double in size. In the 6 cm. stage (second half of the second month) the phenomenon of the formation of the clear cells is regulated; they are not distributed at hazard, but a deep, dark, genetic layer and a superficial layer with clear cells are found. These

cylindrical or polygonal cells have a transparent center with a few granules arranged upon the border.

Some cells in the inferior meatus have numerous slender, short cilia, about 4 mikra in height. In the superior portion of the nasal fossae, the thickness of the epithelium reaches 70 mikra and the cells are longer.

The epithelial plug of the nares made it possible for Laguesse to study the cellular transformations. In embryos of 10.5 to 11 cm. the cylindrical cells are longer; in a large number of cases they are provided with a group of fine cilia, implanted on an expanded projecting surface.

According to Laguesse, the embryonic form passes into the ciliated cylindrical cell by gradual substitution of two sorts of elements.

The epithelium of the olfactory portion, which is thicker, is not subjected to mucous transformation, but remains granular in its entire thickness. Two kinds of elements, described by Max Schultze, are found in embryos of 10 and 15 cm.

The maxillary sinus already exists in an embroyo of 3.5 cm., and is represented by a hollow epithelial involution; in the six centimeter stage, it has the form of a long tube; its cavity is greatly extended in a 13 cm. embryo. At this stage, the epithelium comprises a large number of ciliated cylindrical cells in the midst of mucous cells.

Glands appear in the embryo of 13.5 cm. in the anterior portion of the nasal fossae; they are preceded by a solid epithelial bud.

Hochstetter (1891) gives his personal observations on the formation of the choanae in the cat and rabbit. He is not in accord with the writers in what concerns the formation of the primitive palate. The superior maxillary bud is not concerned in the boundary of the external nasal orifice. The external and internal nasal buds, in fusing, limit the nasal cavity and transform it behind into a cul-de-sac, while it is largely opened anteriorly. An epithelial lamella unites the epithelium of the nasal cavity with that of the buccal roof.

The mesodermic masses fuse and form the primitive palate, after rupture of the epithelial lamina. In the posterior portion, there is only a thin epithelial lamella between the two cavities, the bucco-nasal membrane. This membrane is broken up, establishing an orifice which corresponds to the nasal canal or primitive choana of the writers; at least, the union between

the nasal and buccal cavities is secondary in the cat and rabbit. In 1892 Hochstetter found the bucco-nasal membrane in the human embryo, and, as a consequence, the secondary establishment of the choana.

Zuckerkandl (1892) studied the development of the ethmoidal turbinals in man. In the beginning, the ethmoid forms a ridge projecting into the nasal cavity, and the surface, which should hold the turbinals, has a short sagittal groove, which later becomes the ethmoidal fissure.

The surface is thus divided into two olfactory projections, of which the inferior represents the future middle turbinal; in old embryos, the three turbinals represent the typical fissuration of the ethmoid; sometimes the superior is doubled, making the number four.

Keibel (1893) established in human embryos the correctness of Hochstetter's findings.

Mihalkovics divides the nasal cavity into three zones in a human embryo of three and one-half weeks; the middle zone, the most essential, extends throughout the length of the ethmoidal turbinal; the anterior portion corresponds to the nasal vestibule with a beginning portion of the inferior turbinal, and the posterior zone comprises the region of the sphenoidal sinus and of the naso-pharyngeal canal.

The middle turbinal arises anteriorly as an almost vertical lamina from the superior portion of the lateral nasal wall. The inferior turbinal arises at first from the bottom of the nasal cavity and the inferior meatus is a simple cleft. The superior turbinal is constructed in the posterior part of the middle zone by a thick prolongation of the paranasal cartilage covered by mucosa.

The two walls are fused by bridges of mucosa in the posterior zone, forming above a blind recess which is the anlage of the sphenoidal sinus, and below the naso-pharyngeal canal.

Schönemann (1901) concerned himself with the formation and growth of the turbinals. The lateral wall of the nasal lumen is fissured by epithelial bands forming a sort of epithelial diverticulum in the form of clefts. The projecting part of the wall is established between these clefts; in this way the three primitive fields or primitive buds are formed: the maxillo-turbinal, the naso-turbinal and the baso-turbinal. The entire system of clefts is formed internal to the peripheral skeletal

wall; all are not concerned in the formation of turbinals, certain ones ending in the formation of accessory cavities.

The lumen of the nasal cavity does not correspond to the external form of the snout, and the simple primitive pouch is enlarged by the cavities and clefts. There are established also accessory clefts, longitudinal on the inferior turbinal, and perpendicular to the base of the cranium on the baso-turbinal The high epithelium at the beginning is localized in the fissures, later on the baso-turbinal. It is disposed in rays parallel to the olfactory branches which form the olfactory projections (rabbit 18 days old). In the cat, three clefts, arising from the lateral ethmoidal fissure, penetrate into the mass of the baso-turbinal, and later this formation of clefts is multiplied.

We may distinguish among the turbinals those which are established on the baso-turbinal from those which appertain to the external wall (comprising the naso-turbinal); according to their situation, we may distinguish the choncha obtecta from the choncha aperta.

The field of the naso-turbinal is very much limited; in man it forms only the agger nasi; it is well developed in the cat, ox and rabbit.

The secondary turbinals, which are established on the naso-turbinal, are not well developed in any group of mammals.

Strasser (1901) studied in the series of vertebrates the role which is occupied by the increase of the mesoderm in the formation of the snout and in the location of the nasal fossae. In reference to the turbinals of mammals, according to the opinion of Schönemann, he does not admit that the turbinals take on a proper extension and can thus compel the nasal cavities to increase; they use the disposable space, but do not create it. The expansion of the nose and of the accessory cavities is the result of the increase of the skeleton which the implantation of teeth, the muscles of mastication and the development of the brain necessitates. He finds a sort of law regulating the disposition of the fissures which cut the turbinals into lamellae.

The layers of the inferior turbinal have a longitudinal direction. They are arranged in the direction of the current of air. The clefts and fissures of the ethmoidal turbinals are directed dorso-ventrally parallel to the ramifications of the olfactory nerve.

Karl Peter (1902) finds, contrary to Hochstetter, that the superior maxillary bud in the rabbit, as well as in man, takes

part in the limitation of the olfactory fossette; the external nasal bud enters into the constitution of the primitive palate.

This author, during the same year (1902-1), followed the development of the turbinals and established the homology of these organs in the different groups of the vertebrates. These observations were made on the rabbit and man. As Born established in the sauropsidians, and Schönemann and Legal in the mammals, the formation of the turbinals is due to the separation of parts of the external wall by grooves and not by active growth of the projection. The ventral or maxillo-turbinal projection is thick, the dorsal forms the naso-turbinal. The posterior turbinal, or ethmo-turbinal, originates in a rabbit with a head length of 3.5 mm. from the median wall of the posterior segment of the olfactory fossette. Projections placed in the posterior portion of the lateral nasal wall are distinguished from the ethmo-turbinal. These are the conchae obtectae. Behind the naso-turbinal, the lateral wall sinks into a hemispheric fossa at the level of a convex fold anteriorly and externally; this is the processus uncinatus. The clefts form ventrally the maxillary sinus and dorsally a large groove (recessus posterior superior) which overhang the conchae obtectae.

According to his observations on the rabbit, he separates the turbinals into two groups: those which arise from the external wall (maxillo-turbinal and naso-turbinal), and those which have their origin from the internal wall (ethmo-turbinal).

Beecker (1903) studied Sus domesticus and Ovis aries. He divides the nasal canal into the vestibular, turbinal and cribriform portions; the region of the turbinals is greatly extended in length.

The naso-turbinal (Rhacis) arises from the lateral wall; the maxillo-turbinal corresponds to the turbinal of reptiles.

The organ of Jacobson opens at the anterior extremity of the choanal canal. The choanae are divided into two segments by the growth of the palatal laminae.

The small anterior portion persists as the incisor canal. The large posterior portion opens into the naso-pharyngeal canal. The cribriform portion is established as a new production by a complicated fold from the antorbital wall, which permits five cribriform pockets to bud laterally. On the internal surface, the olfactory projections are exposed in order to surround the entrance of the pockets.

Fleischmann (1903) remarks that whatever the develop-

ment which takes place in the nasal cleft, it always remains a narrow cleft and extends only in height and length.

II. Organ of Jacobson.—The first embryologic investigations are those of Balogh on the sheep and Koelliker on man. Dursy (1869) observed the establishment of the organ of Jacobson in a rabbit as an early hemispheric depression, with large dimensions and thick walls. He found this formation in human embryos 8 to 20 cm. long. Later the organ disappears without leaving any traces, although the cartilage which Huschke describes at the anterior and inferior extremity of the cartilaginous septum seems to indicate it. It persists sometimes at this level under the form of a canal opening into the nasal cavity. There are some differences between the organ of Jacobson of the human embryo and that of other mammals; in the human embryo it is a canal which always remains membranous simply, its orifice into the nasal cavity opening into a fossa leading to the canal of Stenson; it is not surrounded by a cartilaginous lamina and it is situated a little above the thick inferior border of the septum. In other mammals, on the contrary, the canals of Jacobson and Stenson are directly fused, the organ is surrounded by a cartilaginous box and lies very low, and its deep surface is placed on the bottom of the nasal cavity.

Rémy (1878) found this organ in the cat, placed as in the adult, at the angle of junction of the medial septum with the floor. Anteriorly it opens into a cleft which forms the communication between the mouth and the nose, and posteriorly it terminates in the midst of glandular acini. In a 2 cm. human embryo, Rémy found a point corresponding to the epithelial tube, but without cartilaginous envelop. In another embryo of 8 cm. only a poorly defined epithelial mass existed at this place.

Klein (1881) finds the relation of the organ of Jacobson analogous to that of the adult in a 4 cm. embryo of the India pig.

Harvey (1882) describes the relations, in the fetus of a cat, of the organ of Jacobson with the canal of Stenson, the septum and the nasal floor.

Roese (1893) notes the organ of Jacobson in a human fetus 18 cm. long, placed in an antero-posterior cul-de-sac 0.7 mm. long, which opens anteriorly into the buccal cavity. It is situated at the inferior extremity of the septum, almost at the

bottom of the nasal cavity. The basal cartilage of the nasal septum forms the framework of this organ.

Roese observed the organ of Jacobson in an embryo of the wombat 1.9 cm. long, in the form of a tube 0.5 mm. in length; it opened on the inferior wall into the canal of Stenson, and posteriorly it received a large gland. This gland is only a solid epithelial bud in the embryo of an opossum 15.5 mm. long.

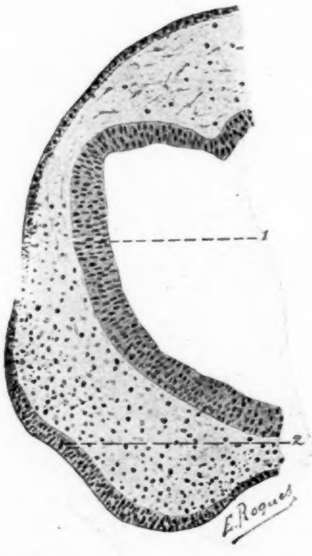

Fig. 44—X 60. Guinea-pig 5 mm. long (transverse section, right side). 1. Nervous system; 2. Olfactory thickening.

Garnault (1895) agrees in what pertains to the rudimentary organ found by Koelliker and does not accept the view of Gegenbaur.

He bases his opinion on the fact that he has met with the organ of Jacobson in the human embryo of 2 or 3 months; on the other hand, he contests the necessity of a connection between this organ and the cartilages of Huschke. These car-

tilages are supporting organs for the septum and their relations with the tube of Jacobson are purely contiguous and accidental.

Mihalkovics (1899) marks the precocious development of the organ of Jacobson of mammals in the form of an evagination of the epithelium of the nasal cavity in the ventral portion

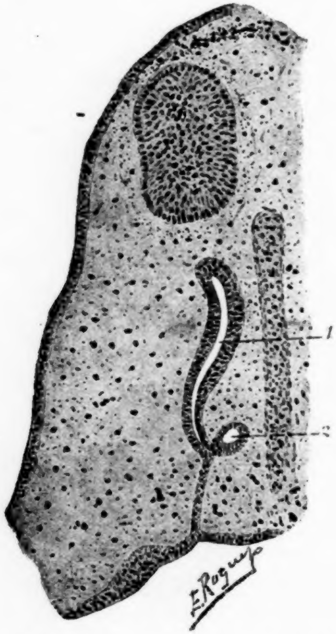

Fig. 45—X 34.3. Guinea-pig 12 mm. long (transverse section, showing the origin of the organ of Jacobson on the internal wall of the cavity, right side). 1. Nasal cavity; 2. Organ of Jacobson.

of the internal nasal bud. He finds it thus in the human embryo of three weeks.

He does not admit the necessity for relation between the organ of Jacobson and the paraseptal cartilage of Huschke.

Tourneux represents the organ of Jacobson in the human embryo above the inferior border of the septal cartilage.

DESCRIPTION OF STAGES. GUINEA PIG (CAVIA COBAYIA). 5 *mm. total length* (Fig. 44).—The ectoderm is formed of a single layer of flat cells. The central nervous system in transverse sections has the form of a heart with point below. At the angle formed by the junction of the ventral with the lateral surface of the head, the ectoderm is thickened in an elliptical zone, 640 mikra long and 428 wide in its middle portion. It has three layers of round cells in process of division (Fig. 44). The dorsal third of this zone sinks into a fossette and the depression, more and more marked towards the posterior region, has only a very slight depth. It penetrates directly internally into the mesenchyme. The cells of the olfactory thickening are all round.

6 *Millimeters.*—The anterior portion of the nervous system, in transverse sections, is a large vesicle divided into two dilated portions, communicating by a canalicular portion. The ectoderm has only a single layer of cubical cells with a large nucleus. The olfactory region has three or four layers of round cells; it is depressed into a deeper fossette. Two masses of mesenchyme limit it laterally: one internally, the other externally.

12 *Millimeters.*—The olfactory groove is opened below in the anterior region, as in the preceding stages: then the internal and external buds are fused in order to form a floor which constitutes the primitive palate. This floor has a length of 540 mikra; at its level the cavity is closed and elongated vertically (Fig. 45). Near the inferior extremity of the internal wall, a depression extending vertically sinks into the septal mesenchyme. It has the form of a groove for 340 mikra, and behind it is prolonged in the form of a cylindrical canal detached from the nasal wall and isolated in the septum; this is the organ of Jacobson.

The cavity elongates inferiorly behind the primitive palate and communicates with the buccal cavity. As Hochstetter states in the cat and man, a bucco-nasal membrane exists in the guinea pig, formed by a single layer of flat epithelial cells, closing the choanal fissure.

In the region of the choanal clefts, the external wall of the nasal cavity presents two convex projections separated from one another by a short fissure directed externally. The vertical extent of the inferior projection is 378 mikra and that of the superior 192. They represent the naso-turbinal and maxillo-

turbinal. The most elevated portions of the nasal cavity (roof and adjacent portions of the internal and external walls) present a thick epithelium of which the superficial cells are cubical or cylindrical.

The canal of Jacobson has a thick epithelial wall, and the most internal layer is formed of very clearly differentiated cylindrical cells.

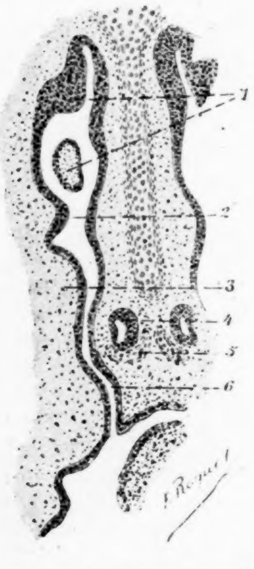

Fig. 46—X 34.3. Guinea-pig 14 mm. long (transverse section, showing fields of origin of the different turbinals, right side). 1. Ethmo-turbinals; 2. Naso-turbinal; 3. Maxillo-turbinal; 4. Organ of Jacobson; 5. Paraseptal cartilage; 6. Choana.

14 *Millimeters.*—The olfactory cavities are displaced transversely, and open on the lateral surface of the head. The entrance of the cavity is occupied by epithelial tissue with large round or polyhedral cells over an anteroposterior extent of 120 mikra. The cavity penetrates into cellular mass under the form of a central lumen. From the anterior extremity of this

lumen, the external wall has a ridge which bounds two fissures, one directed vertically downward, the other, superior, directed externally and upward. This ridge, or inferior turbinal, occupies at its anterior extremity the entire vertical extent of the external wall; this increases in height from before backward, and is divided into two fields by an external fissure, as in the preceding stages. Above this fissure, the external walls presents the ridge of the naso-turbinal (Fig. 46). This turbinal begins 170 mikra back of the anterior extremity of the maxillo-turbinal. It has a length of 840 mikra and the maxillo-turbinal measures 1.1 mm.

The cavity increases transversely behind the naso-turbinal and presents another turbinal at the junction of the external and superior walls. It is freely prolonged anterior to its pedicle into the cavity for a length of 270 mikra; the pedicle is 130 mikra long (Fig. 46). The superior wall at this level has another ridge limited laterally by fissures which rise vertically. These last two ridges are the ethmoidal turbinals. In their entire extent and in the corresponding region of the septum, the epithelium has sensory characteristics.

The organ of Jacobson has the same disposition as in the preceding stage, but its posterior extremity does not reach the choana. A cartilage in the form of a groove, opened externally and superiorly, lodges this organ; it is in relation with the internal and inferior surfaces (Fig. 46); this is the paraseptal cartilage. The choana still has the disposition of a primitive palatal cleft, but the bucco-nasal membrane no longer exists. It is less extensive anteroposteriorly on account of the elongation of the primitive palate. The posterior extremity of the cavity behind the choana is a diverticulum, which fusion of the ethmoidal turbinals with one another and with the internal wall divides into several spaces.

SHEEP (OVIS ARIES) 8 *millimeters.*—The olfactory outline is a thickening of the ectoderm situated on the ventral wall of the head, below the nervous system, slightly depressed into a fossette. The cells of the superficial layer are cubical and clear in the bottom of the fossette.

10 *Millimeters.*—The olfactory fossette is deep and widely open below; the mesodermic masses which limit it internally and externally are fused for a slight extent. Behind this bridge of fusion, the fossette is separated from the nasal cavity

by a thin bucco-nasal membrane. The fossette in its middle portion has a depth of 357 mikra and a width of 107 at the level of its superior third. Its internal wall presents a depression in the form of a longitudinal groove, which is the anlage of the organ of Jacobson. This groove, which is 240 mikra long, begins 105 mikra behind the anterior extremity of the olfactory groove and stops 187 mikra from its posterior extremity; it has a length of 92 mikra and a depth of 42 in the region where it is best marked.

The epithelial layer at the level of this depression and over

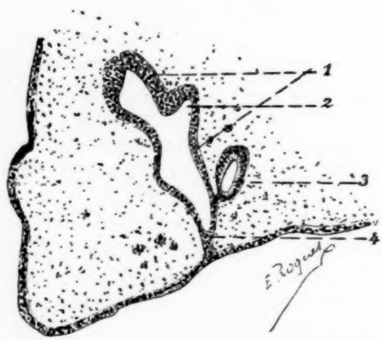

Fig. 47—X 34.3. Sheep of 14 mm. total length (transverse section, showing the internal wall of the nasal cavity divided into two segments, right side). 1. The two segments of the internal nasal wall; 2. Groove showing the summit of the angle of flexion; 3. Organ of Jacobson; 4. Fusion of nasal buds.

the whole of the internal wall of the nasal cavity has a thickness of 71 mikra, while it is almost a half less at the level of the external wall. The superficial layer of epithelium in the organ of Jacobson and in the bottom of the olfactory fossette is formed by elongated cells.

11 *Millimeters.*—The olfactory cavity is larger and deeper; the depression of Jacobson is increased. The epithelium which covers this groove is thick, like that which covers the bottom of the fossette, and the cells have a less elongated form.

12 *Millimeters.*—At the level of the organ of Jacobson the superficial epithelial cells may be clearly seen taking a cylindrical form and presenting an excessively clear internal extremity, while the peripheral portion is sunken and contains the nucleus.

14 *Millimeters*. (Fig 47).—The olfactory cavity has acquired a large size; the organ of Jacobson 217 mikra long,

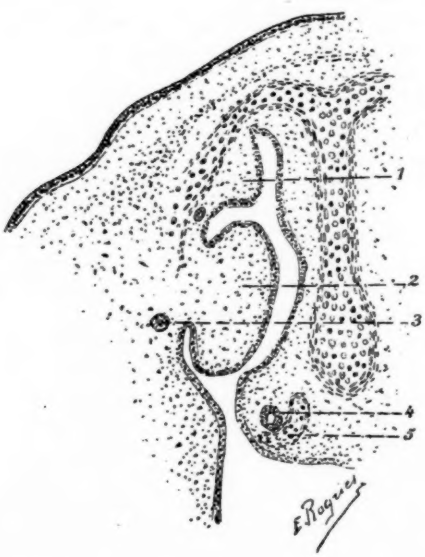

Fig. 48—X 34.3. Sheep 25 mm. long (transverse section, right side). 1. Naso-turbinal; 2. Maxillo-turbinal; 3. Lachrymal canal; 4. Organ of Jacobson; 5. Paraseptal cartilage.

is a groove for a tract 150 mikra long, the remainder of its extent having the form of a cylindrical canal isolated from the nasal wall and free in the mesenchyme of the septum. It begins 480 mikra from the anterior extremity of the cavity.

The primitive palate is very extensive, its length being 382 mikra. The olfactory cavity has a height, or depth, of 857 mikra at the level of the anterior extremity of the choana. The

bucco-nasal membrane still exists. The internal wall is vertical for an anteroposterior extent of 480 mikra; from this point, it presents a sort of longitudinal furrow which divides it into two segments: one, anterior, which remains vertical, the other, superior, which is oblique from below upwards and from within outwards (Fig. 47). The furrow parallel to the nasal floor is placed 571 mikra above it. The nasal roof does not exist, so to speak, in the anterior portion of the cavity; it is formed by the round bottom of the primitive olfactory groove, but the furrow, after an anteroposterior projection of 97 mikra, becomes deeper and the superior segment of the internal wall is inclined more and more externally.

The epithelium which covers the superior segment of the internal wall and the furrow which limits it below is much thicker than that of the inferior segment of this wall; it has the same characteristics as it has on the nasal roof. The external wall of the cavity presents a convex ridge.

15 *Millimeters.*—The most interesting transformations occur in the superior segment of the internal wall. The furrow which limits it is transformed into a fissure 425 mikra deep, directed superiorly and internally.

The superior portion of the internal wall is now directed transversely and forms the roof of the cavity. This roof is strongly convex inferiorly in its anterior portions, and horizontal in its posterior portion. This region thus displaced will form the largest extent of the ethmoidal field.

25 *Millimeters.* (Figs. 48 and 49).—The external opening of the nasal cavity is situated on the dorso-lateral surface of the head and passes into a cavity in the form of a fissure elongated vertically, but oblique downwards and outwards, the walls of which are convex externally and concave internally.

The convexity of the external wall continues to increase and is very pronounced 240 mikra behind the external nasal orifice; below it fuses with the nasal wall, while above it is separated from it by a fissure directed externally and inferiorly.

It is pedunculated 340 mikra from its anterior extremity and represents clearly a turbinal; this is the maxillary turbinal (Fig. 48), which has the form of a convex process, leaving its pedicle in a symmetrical manner above and below; it has as yet no coiled lamina. The lachrymal canal opens on the nasal wall below this turbinal.

The external wall, above the fissure forming the superior limit of the maxillo-turbinal, has another ridge, less marked and shorter than the first, corresponding to the naso-turbinal (Fig. 48). The cavity is enlarged behind the naso-turbinal in order to lodge the ethmoidal turbinals. One of them arising from the superior portion of the external wall, is pedunculated and voluminous.

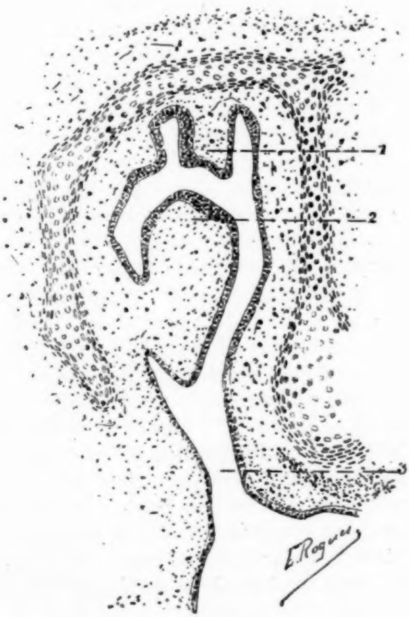

Fig. 49—X 34.3. Sheep 25 mm. long (transverse section, posterior to that shown in Fig. 48, passing through the posterior extremity of the primitive choana). 1 and 2. Ethmo-turbinals; 3. Primitive choana.

Two others, lying on the superior wall, are simple ridges limited by vertical fissures. All the turbinals and the internal wall in its superior portion have a thick epithelial investment with cylindrical cells (Fig. 49).

The organ of Jacobson opens into a furrow only in a small portion; everywhere else it is a cylindrical canal placed towards the inferior border of the septum, below the cartilage of the septum. It is incompletely surrounded by the paraseptal cartilage (Fig. 48). Its total length is 1.26 mm. while the nasal cavity measures 2.86 mm. The organ of Jacobson begins 500 mikra behind the anterior extremity of the nasal cavity. The epithelial wall is very thick, the total diameter of the canal at its most voluminous point being 150 mikra while the lumen is only 28. The epithelium is of a sensory nature over the whole lumen.

The choana is arranged like a palatal cleft. The posterior extremity of the cavity contains only the ethmoidal turbinals, and these by uniting together partition the cavity. This region is entirely covered by sensory epithelium.

The cartilaginous skeleton forms the external, superior and septal walls; it still does not send any cartilaginous axis into the turbinals.

7 *Centimeters.*—The external forms are those of the adult; the snout has reached its complete development. In a sagittal section we see that the external wall carries a maxillo-turbinal analogous to that of the adult. The ethmo-turbinals are formed by a process directed obliquely from above downward and from before backward, parallel to the posterior border of the maxillo-turbinal; its superior portion after bending is directed backward. This process forms thus an incomplete framework in the area of which are disposed four small longitudinal processes, united together by their anterior extremities. There is found along the nasal roof a small process, the middle portion of whose inferior border extends between the maxillo-turbinal and the anterior ethmo-turbinal; this is the naso-turbinal.

The maxillo-turbinal presents in transverse sections two coiled laminae, and we see the naso-turbinal inserted at the superior boundary of the external wall.

CALF. We have examined some calf fetuses of large dimensions. In a subject measuring 2 cm., the turbinals are well developed and the inferior turbinal is divided into two coiled laminae, one superior and the other inferior. The ethmoidal cells and the maxillary sinus are of considerable dimensions.

The sphenoidal sinus in a 14.5 cm. embryo forms a cavity

occupying the whole of the body of the sphenoid; this is the most remote portion of the ethmoid region, unoccupied by the turbinals and separated from the nasal cavity.

MOLE (TALPA EUROPOEA). 4 *Millimeters.*—The beginning of the olfactory anlage is an ectodermic thickening placed at the level of the union of the ventral and lateral surfaces of the head. It is a disc 292 mikra long and 428 wide in its middle portion. Its maximum thickness is 42 mikra. It is composed of round cells. The first trace of cellular differentiation is indicated by the fact that for a slight extent of the disc the superficial cells are clear in their external segments, and present a nucleus more removed from the surface than that of the adjoining cells. This shows that the elements are beginning to elongate.

5.5 *Millimeters.*—The olfactory thickening is depressed into a deep fossette, the mesodermic buds which limit this fossette laterally are fused behind to an anteroposterior extent of 90 mikra. The epithelial wall of the fossette is thick, being 57 mikra at the bottom. There is no groove representing the organ of Jacobson.

The superficial layer of epithelium contains cubical or cylindrical cells distributed to the bottom of the fossette and the internal wall. These cells have a central clear extremity, and their nuclei are about 10 mikra from the surface, while at the level of the internal wall their distance from the border is 5 mikra. This difference measures the lengthening undergone by the epithelial cells.

6 *Millimeters.*—The olfactory fossette is deep and directed vertically from below upwards. The organ of Jacobson appears as a depression in the form of a furrow placed on the internal wall towards its inferior third. At the level of this furrow, the cells are cylindrical and have a central clear extremity while elsewhere they are still round.

7 *Millimeters.*—The primitive palate is formed; the choana is covered behind by the bucco-nasal membrane. The organ of Jacobson has about the same disposition as in the preceding stage.

9 *Millimeters.*—The olfactory cavity is large, 1.06 mm. in total length; anteriorly it is opened for an extent of 60 mikra; the primitive palate measures 450 mikra in an anteroposterior direction and the choana 360. The cavity is pro-

longed behind the choana in the form of a cul-de-sac flattened transversely.

It has a height at the level of the choana of 857 mikra and an average length of 42 mikra, but it is enlarged transversely by a fissure directed outward and separating the two projections of the external wall from one another. The inferior projection, anlage of the maxillo-turbinal, begins 90 mikra behind the anterior extremity of the cavity and continues for a length of 780 mikra. The ridge situated above, the naso-turbinal, does not begin until 195 mikra behind the anterior extremity of the maxillo-turbinal and has a length of 585 mikra.

Behind the naso-turbinal, the dorsal region of the cavity is enlarged and lodges the ethmoidal turbinals. One, very large, is inserted on the external wall; the other, less projecting, is situated on the superior wall. They do not reach the posterior extremity of the cavity.

The sensory epithelium covers the posterior segment of the cavity. the ethmoidal turbinals and, in front of these, the nasal roof and the portion of the external and internal walls adjoining. Its thickness reaches 50 mikra at the level of the nasal roof.

The organ of Jacobson has a length of 217 mikra; it begins 465 mikra behind the anterior extremity of the nasal cavity and opens into a furrow 83 mikra in extent; in the remaining portion of its extent it is an isolated cylindrical canal in the septum. The average diameter of the canal is 78 mikra and of the lumen 35.

17 *Millimeters.*—Differences exist in the dimensions of the nasal cavity, but especially in the extent of the turbinals. The maxillo-turbinal is a large ridge, the naso-turbinal is very distinct; the ethmoidal turbinals are inserted one on the external wall, and two on the superior wall.

MAN. 8 *Millimeters* (from the 28th to the 30th day).—The olfactory anlage is already quite a deep fossette which is transformed posteriorly into a cylindrical canal by fusion of the lateral mesodermic buds. This fossette is open for a length of 320 mikra; its situation is the same as that of other mammals.

The fossette measures 335 mikra in depth where it is largest and 71 mikra in average width. It is closed for a distance of 140 mikra and it forms behind a solid epithelial cord.

The internal wall and bottom of the groove has a superficial layer of cubical cells with clear protoplasm, very fine reticulum and basal nucleus. The other cellular layers are formed of round cells; epithelium is 85 mikra thick at bottom of the groove.

19 *Millimeters* (middle of the second month; Fig. 50). —The nasal organ opens on the dorsal surface of the

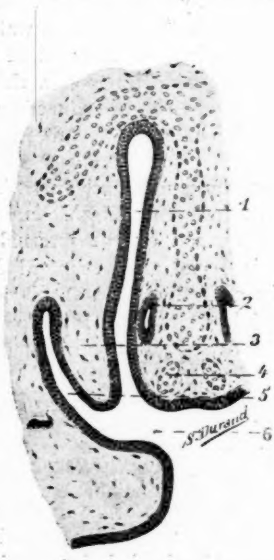

Fig. 50—X 34.3. Human embryo 19 mm. long from vertex to coccyx (middle of second month of pregnancy), (transverse section, right side). 1. Nasal cavity; 2. Organ of Jacobson; 3. Inferior turbinal; 4. Paraseptal cartilage; 5. Fissure limiting the inferior turbinal below; 6. Primitive choana.

cephalic region but in its anterior segment it has no lumen, and it is composed of an epithelial mass which a regular and more sunken layer separates from the surrounding mesenchyme. This peripheral layer is continuous with the ectoderm and the epithelial mass projects on the outer side of the fossette. The region covered by this epithelial mass has a length of 330 mikra. Then the lumen begins at the center of the mass

and increases from before backward. From the beginning of the region provided with the lumen, the external wall presents a convex ridge intercepted by two fissures, which penetrate into the mesoderm. This ridge, the inferior turbinal, has a length of 230 mikra. In its middle portion there is only one inferior fissure present, circumscribing the ridge (Fig. 50), while at its posterior extremity there is only one superior fissure; this is directed deeply downward and outward, detaching the turbinal from the wall. The external wall presents a slight ridge in its superior region, at the level of the posterior extremity of this turbinal; opposite to this ridge, the septum is thickened, causing the lumen to be reduced to a simple slit, but the segment thus constituted has an anteroposterior extent of 70 mikra.

The organ of Jacobson is much advanced in its development, beginning 440 mikra from the anterior extremity of the cavity. It forms a depression on the internal wall only for a short distance. It is closed and separated from the wall for the remainder of its extent. It is 200 mikra long, its vertical diameter is 271 and its transverse is 121. It lies 394 mikra above the inferior border of the septum. Two small paraseptal cartilages lie below the septal cartilages.

The primitive palate is 220 mikra long and the choana 360 anteroposteriorly. Behind the choana, the cavity is nothing more than a vertical slit.

24 *Millimeters* (end of the second month).—The general arrangements are analogous to those of the preceeding stage: there is an epithelial plug; on the external wall, there is a ridge destined to provide the inferior turbinal; the superior portion of the cavity is covered with very thick epithelium; finally, the organ of Jacobson has the same place in the septum and the same relations with the nasal wall.

The cartilaginous envelop is slightly more extended. The two choanae unite in a region limited by the palatal buds and obstructed in part by the ridge of the tongue. This passageway has a width of 1.37 mm. and a length equal to that of the choanae, 1.20 mm. The inferior turbinal projects into this passageway, the groove which limits it inferiorly being situated, depending on the position, at a distance of 75 to 150 mikra below the inferior border of the septum. The latter reaches 1.12 mm. below the inferior border of the palatal buds. At a distance of 560 mikra behind the anterior extremity of

the choana, the external wall presents, in its superior segment, a less prominent ridge, 175 mikra long, covered by epithelium thicker than that of other points of the wall—this is the primary anlage of an ethmoidal turbinal.

32 to 40 *Millimeters—Horizontal Sections* (6th day.)—The nasal cavity ends below in a passageway in which it joins with that of the opposite side. On the external wall are found pro-

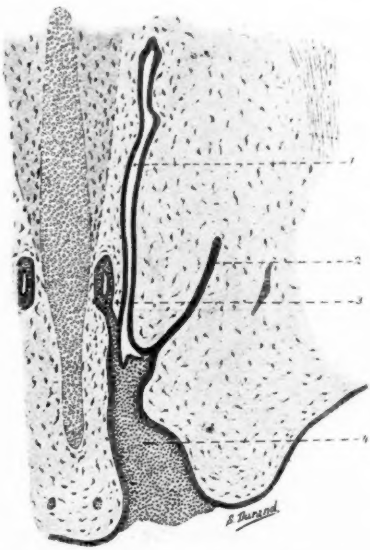

Fig. 51—X 20. Human embryo 32-40 mm. long beginning of third month), (horizontal section, left side). 1. Nasal cavity; 2. Epithelial bud limiting the area of the inferior turbinal, anteriorly; 3. Organ of Jacobson; 4. Vestibular epithelial plug.

jecting portions, marked by grooves, which give rise to the inferior turbinals and the ethmoidal turbinals. The ethmoidal region lies in the upper half of the cavity only, and its extent increases from below upward. It decreases again towards the apex of the cavity, in which it has the form of an anteroposterior furrow 750 mikra long. Above the primitive palate, in

the more extended region, the cavity measures 2.87 mm.; at this level, the ethmoidal region is 950 mikra long on the external wall.

The cavity is longest above the primitive palate, but it is not provided with a lumen throughout its extent, the anterior portion being occupied by the epithelial plug (Fig. 51). The length of the lumen is 2.25 mm.; the epithelial plug measures

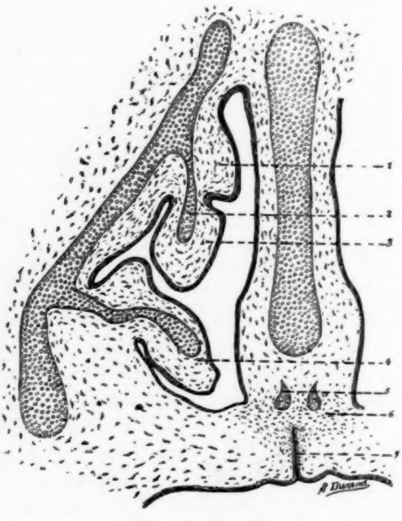

Fig. 52—X 20. Human embryo 47-60 mm. long (middle of third month), (transverse section, right side). 1. Superior turbinal; 2. Cartilaginous axis of middle turbinal; 3. Middle turbinal; 4. Inferior turbinal; 5. Paraseptal cartilage; 6. Fusion of septum and palatal laminae; 7. Fusion of palatal laminae.

1.50 mm. anteroposteriorly and 600 mikra transversely; its thickness or height is 403 mikra. The epithelial plug is limited laterally by a more depressed cellular layer, which continues the lateral nasal wall and unites with the ectoderm; it forms a ridge at the level of the external orifice.

The cavity has a length of 2.87 mm. above the epithelial plug and the ethmoidal region measures 950 mikra on its ex-

ternal wall. The cavity is limited below the plug, anteriorly, by the primitive palate, and is represented only by the palatal cleft, the length of which is 2 mm. The anteroposterior extent of the primitive palate is 1.62. The internal wall sends out the canal of Jacobson in the region provided with lumen, at the level of the plug. The section passes anteriorly across one of the walls of this organ and behind influences the lumen (Fig. 51). Its junction with the cavity is 1.60 mm. from the external orifice.

The cartilaginous skeleton, incomplete in the inferior and medial regions of the cavity (septum and lamina isolated in the mesenchyme of the external wall), forms a complete envelopment in the superior region.

47 to 60 *Millimeters* (76th day; Fig. 52).—The nasal cavity has already acquired the form which it will have in the adult; it is provided with a lumen throughout by virtue of the almost complete resorption of the anterior epithelial plug. It has three turbinals with the beginning of the maxillary sinus. The inferior turbinal is 3.32 mm. long, the middle turbinal 2.19 mm., beginning 670 mikra behind the anterior extremity of the inferior turbinal; the superior turbinal is 1 mm. long and begins 1.13 mm. from the anterior extremity of the middle turbinal; all the turbinals are inserted upon the external wall (Fig. 52).

The lachrymal canal, composed of a solid epithelial bud, opens in the groove which limits the inferior turbinal below.

The groove which separates the inferior turbinal from the middle is dilated into the shape of a flask at its bottom and forms a recess 780 mikra long, 875 high and 200 wide; it represents the beginning of the maxillary sinus. The skeletal lamina of the external wall limits it externally (Fig. 52). The organ of Jacobson is no longer in communication with the nasal cavity; it has the same position in the septum commencing 1.5 mm. behind the external orifice, and being 240 mikra long. It forms a solid cellular cord at its anterior and posterior extremities.

The epithelial plug, which obstructs the anterior portion of the cavity in the preceeding stages, is very much reduced; at the entrance of the external orifice, it occupies scarcely the inferior third of the cavity and it diminishes in importance from before backwards, being represented only by an irregular mass, attached to the internal and inferior walls.

Some vestiges of the plug exist for a length of 1.4 mm.

The cells which constitute it are large, polyhedral and very clear, having a mean diameter of 12 mikra; the protoplasm is not stained by carmine; the cellular border is barely visible; the nucleus is smaller than that of the epithelial cells of the wall, irregularly colored, presenting portions that are clear and portions that are depressed.

The skeleton forms a thick lamina limiting the cavity externally and giving an axial lamella for each turbinal, that of the superior being very short; the septum lies internal. The two small paraseptal cartilages are placed below this (Fig. 52).

The primitive choanae no longer exist, and palatal laminae separate the buccal cavities from the nasal cavity. Fusion of the two palatal laminae is still indicated by a vertical epithelial band in the median line. the septum is fused throughout with the palatal laminae and the zone of union is marked by denser and more colored mesenchyme (Fig. 52). The palatal laminae (secondary palate) have a thickness of 600 mikra while the primitive palate (in the region of the epithelial plug) measures 1.45 mm.

80 to 100 *Millimeters* (beginning of the 4th month).—The turbinals and the anlage of the maxillary sinus have the same arrangement as in the preceding stage. Some osseous spaces appear in the palatal laminae in process of organization. The organ of Jacobson, which opens into the nasal cavity by its anterior extremity, has a length of 560 mikra and a diameter of 107 in its middle portion.

The epithelial plug still exists in the anterior portion of the cavity, but, as in the preceding stage, it is represented only by an irregular cellular mass distributed to the inferior third of the internal and external walls and to the floor of the nose.

Glands make their appearance in the form of epithelial buds arising from the internal and external walls. Some of these solid buds are adherent to the nasal epithelium, some isolated in the mesenchyme. Some, but rarely, are provided with a slight central lumen. Some have a length of 114 mikra, others of 150.

The lachrymal canal is permeable throughout almost its entire extent.

Numerous vessels are in the mesenchyme of the internal and external walls; they are particularly abundant along the superior boundary of the pedicle of the inferior turbinal.

160 to 235 *Millimeters* (middle of the 5th month).—Below

the middle turbinal, the external wall forms a small longitudinal ridge containing a cartilaginous ridge, representing an accessory turbinal, the fourth ethmoidal turbinal. The maxillary sinus is very well developed; it is almost entirely surrounded by bony walls formed by the superior maxillary. It extends vertically between the axis of the inferior turbinal and that of the middle turbinal; it is covered by an epithelium analogous to that of the nasal fossae; between the epithelial wall and the bony wall is found connective tissue containing vessels and glandular buds. This connective tissue layer has a thickness of 300 mikra.

The sinus in almost all the transverse sections is divided into two compartments; we have been unable to find the point of communication between the sinus and the nasal cavity.

Numerous glandular buds are found throughout the nasal cavity, particularly over the inferior turbinal; they are branched, representing the beginning of clusters of glands. They are provided with a lumen, reaching a length of 575 mikra.

The organ of Jacobson is of reduced dimensions; its mean diameter is 160 mikra.

Beginning and Evolution of the Olfactory Organ.—We find the ectodermic thickening corresponding to the nasal field of His in 5 millimeter embryos of the guinea pig, 4 millimeter mole and 8 millimeter sheep.

The cells which compose it have the embryonic form, round and pressed upon one another; nevertheless the cells of the superficial layer already show the onset of differentiation; they are elongated, the nucleus is basal and removed from the surface; the protoplasm is clear with a fine network of barely visible granules scattered through it.

The thickening hollows into a fossette which sinks into the mesoderm, at first dorsoventrally, then enlarges anteroposteriorly. This fossette is limited laterally by mesodermic masses or nasal buds. According to Koelliker, Dursy and His, the nasal and superior maxillary buds fuse and for a small distance close the nasal cavity below. The zone in which this fusion is made is the primitive palate. Anteriorly, the fossette is widely open and posteriorly, in the form of a cleft, it corresponds to the buccal depression. This cleft is the primitive choana or palatal cleft of Dursy.

Hochstetter (1891 and 1892) has shown in the cat, rabbit and man, that the palatal clefts are not open at the beginning but are closed by an epithelial membrane which he calls the bucco-nasal membrane. The choanae are formed by absorption of this membrane.

Keibel (1893) confirms the exactness of Hochstetter's description in the human embryo and Peter (1902) in the rabbit. We have found this bucco-nasal membrane in the guinea-pig, sheep and mole; it is a very thin pellicle formed of a thin layer of flat cells extending from one border of the choanal fissure to the other. It is still present in the guinea-pig of 14 mm. and in the sheep of 15.

Later, the primitive choana unites no longer with the buccal cavity, the latter being separated from the nasal cavity by the secondary palate (palatal laminae of Dursy). In the human embryo of 24 mm., we have shown that the lower limit of the maxillo-turbinal is subjacent to the septum situated in the bucco-nasal passageway which receives the two choanae. This shows us clearly that the superior region of this passage will later belong to the nasal cavities. The palatal buds, visible from the stage of 19 mm. in the human embryo, are directed at first obliquely downwards; the tongue, occupying the entire height of the buccal cavity, comes almost in contact with the septum, and it is not possible that the palatal laminae are developed from within. As has been well noted by Dursy (1869), the tongue is later drawn downwards and the palatal processes take a horizontal direction. According to Mihalkovics, they begin to fuse towards the ninth or tenth week.

In a human embryo of 47 to 60 mm., fusion of the palatal laminae is affected throughout the primitive choanae and they are at the same time united with the nasal septum (Fig. 52).

The nasal septum sinks down anteriorly between the palatal laminae; the fusion persists in the zone of contact under the form of an epithelial band directed obliquely inwards and downwards and placed near the median line. A lumen appears later in this tract and thus establishes a communication between the nasal and buccal cavities; the canal thus formed is the canal of Stenson (Peter 1902, 1903).

The growth of the nasal buds and the superior maxillary, and, consecutively, the extension of the primitive palate cause modifications in the neighborhood of the internal orifice. It is closed in all parts and forms an elliptical opening on the facial plane.

The nasal canal is lengthened anteroposteriorly in the passageway of the fused buds. The epithelial buds grow and a long epithelial plug appears, obliterating the cavity at this level; this plug forms a ridge at the level of the external orifice by resorption of the central cells (process observed in reptiles and birds); this mass is penetrated by the nasal lumen from before backwards. (See human embryo, stages of 24, 32 to 40, and 47 to 60 mm.)

This is the plug in which Laguesse (1885) could most easily follow the mucous transformation which precedes the appearance of ciliated cylindrical cells. This writer has studied minutely the histogenesis of the respiratory epithelium; the embryonal cells in the nasal cavity are changed; large vacuoles appear on the surface of their protoplasm, filled with a transparent mucous liquid; other cells, uniformly granular and containing one or two vacuoles, are supplied with cilia on their surfaces. Laguesse notes a very incomplete mucous transformation in the region of the olfactory spot.

The turbinals appear very early: mole of 9 mm., sheep of 15, very clear in guinea-pig of 12, slightly outlined in human embryo of 19.

According to our observations on the guinea-pig, the sheep and the mole, a turbinal is developed on the inferior half of the external wall (maxillo-turbinal), another on the superior half of this same wall (naso-turbinal; Figs. 46 and 48).

These two turbinals have in common the disposition of being extended anteroposteriorly in the anterior and middle regions of the nasal cavity.

Other turbinals are formed in the posterior region of this cavity, one on the external wall and two or three on the superior wall (ethmo-turbinals; Figs. 46 and 49).

The turbinals take their origin from the parietal processes limited by fissures or grooves. The process which we have followed in reptiles is found in mammals; it has been observed by Schönemann (1902), Strasser (1901) and Karl Peter (1902-1). It is clearly visible in different embryos at the beginning of the development (rabbit, sheep, guinea-pig).

The initial phenomenon is fissuration of the epithelial buds, arising from the nasal wall and extending into the surrounding mesenchyme; later the buds, isolated from the wall, increase in dimensions by growth of the mesenchyme which they enclose.

In order to classify the turbinals, Peter used their origin as a basis: the maxillo- and naso-turbinals orginiate from the external wall and the ethmo-turbinals from the inner wall. This writer observed the internal wall divided, in the rabbit, into two portions by an angle of flexion (Knickung der medialen Wand), the superior portion being destined to furnish the ethmoidal turbinals.

This observation of Peter is correct. We have followed the transformations of the internal wall in embryos of the sheep of 14 (Fig. 47) and 15 mm. (See stage of 14 mm.) A longitudinal furrow exists towards the superior third of this wall in the 14 mm. embryo, below which the wall is vertical and the epithelium thin, while above it the wall, formed of thick epithelium, is inclined obliquely upward and outward; the groove is the apex of a dihedral angle whose sides are formed by two segments of the internal wall.

The groove, in the 15 mm. embryo, becomes a very deep fissure, which prolongs the nasal lumen above; the internal wall is vertical, and there is a wide superior wall with convexity inferiorly, which results from the displacement of the superior segment of the internal wall.

All embryos which we have examined present ethmoidal turbinals on the superior wall and adjacent portion of the external wall. The superior wall has a segment of the primitive internal wall, causing the ethmoid turbinal field to have in large part a septal origin. Peter's classification depends on this fact, but it must be admitted that this shows only at the beginning of development, for at the time that the turbinals appear the change in position of the walls is already accomplished.

Nevertheless, Peter's distinction should obtain with reference to the naso-turbinal.

This turbinal, in fact, is more to be compared to the maxilloturbinal than to the ethmo-turbinals. It is not its insertion on the external wall that removes it from the latter, because certain of them take their origin there. It is on account of their early appearance and the anterior position of their field of origin, that makes it possible to group the naso-turbinal with the maxillo-turbinal.

This distinction (anterior turbinals and posterior turbinals) persists in the adult except in man, in whom the anteroposterior

shortening of the facial framework causes the different turbinals to be superimposed vertically.

The ethmoidal turbinals, inserted on the ethmoid, grow anteroposteriorly in such a manner as to present an anterior free extremity. There are only three turbinals in the stages which we have studied in the different mammals; others are formed later; we have seen that the number varies in adults. Killian finds six grooves limiting six olfactory processes in human fetuses from 9 to 10 months.

The first will form the agger nasi and the uncinate process; the others, from 1 to 5, the ethmoidal turbinals. Besides these turbinals, Killian finds accessory turbinals (conchae obtectae) in the principal grooves and in addition the processes may present accessory grooves.

Generally, six processes are rare in man: Zuckerkandl describes four which he finds in the adult (see Morphology). According to Wiedersheim (1902), the reduction of the number of turbinals in man is caused by the ascending branches of the ethmo-turbinals and by effacement of the primary grooves.

He establishes, thus, the origin of the different olfactory turbinals in man: inferior turbinal = inferior process; middle turbinal = descending branch of the first principal turbinal + a small portion of the ascending branch; superior turbinal = descending branch of the second principal turbinal or of the second, third and fourth turbinal; supreme turbinal (Santorini) = descending arm of the third and fourth turbinal.

The development of the sinuses is given in a large number of works; Dursy (1869) was the first to show that the accessory cavities of the nose originate at first under the form of diverticula of the mucosa surrounded by cartilage, without bony walls at the beginning. According to Koelliker (1882) the sinuses of the mucosa, enveloped by cartilage, extend, and the neighboring bones form simply an external envelope; then the cartilaginous capsule disappears without ossifying, and beginning with that time the cavities are immediately limited by the bones.

As Schönemann, Strasser and Mihalkovics have established, there are certain fissures which preside over the formation of the turbinals which give origin to the sinuses.

Rémy (1878) established the appearance in man of the ethmoid cells first, then the maxillary sinus at 4 months, the sphe-

noid towards the end of the first year and the frontal sinus from 7 to 8 years.

Laguesse (1885) saw the beginning of the maxillary sinus in the sheep embryo of 3.7 cm., in the form of an invagination of the mucosa, directed from within outward and from behind forward.

We found the maxillary sinus and the ethmoid cells in a calf fetus of 11 cm.; the maxillary sinus appeared in the human embryo of 47 to 60 mm. in the form of an expansion of the groove separating the inferior turbinal from the middle turbinal (Fig. 52).

The sphenoidal sinus is formed by isolation of the posterior region of the cavity under the influence of fusion of the different ethmoidal turbinals; this process is to be observed in the guinea-pig and sheep.

According to Killian, the ethmoid cells originate from the groove situated between the olfactory processes; the third groove gives origin to one cell; the second to two cells, one superior and one inferior; from the first division arise: a superior recess giving origin to superior ethmoid cells, an inferior recess, to the inferior cells of the lachrymal; from this groove, also, the frontal recess arises.

Steiner (1871) considers the appearance of the frontal sinus as connected with the beginning of the cartilaginous ethmoidal labyrinth. The development of the frontal cavity begins with that of the cellular spaces of the anterior ethmoid labyrinth; it is established between the first and second year. The type of development under the influence of the ethmoid labyrinth is conserved in the adult cranium.

Mouret (1901) concludes from a long study of the frontal sinuses that they are formed by the extension of an ethmoid cell into the thickness of the frontal; inasmuch as the cells concerned are not always the same, the excretory orifice of the sinus does not always occupy the same place and is not always at the extremity of the fossa of the infundibulum. The formation of frontal bullae and of supplementary frontal sinuses is very well explained by extension of the different ethmoid cells.

Killian has already admitted the possibility of the origin of the frontal sinus being dependent upon the different olfactory grooves.

Laguesse observed the appearance of glands in a sheep embryo of 3.5 cm. under the form of epithelial buds.

The lateral nasal gland discovered by Steno, observed in its evolution by Jacobson, Kangro and Schwink, is established at various periods: before the formation of the cartilaginous cranium (goat, rabbit), after the beginning of ossification (calf). It originates at the level of the anterior extremity of the nasoturbinal, at the commencement of the middle meatus, in the region of the sensory epithelium. Kangro, in the elan, finds a glandular depression in the superior meatus. On account of its origin in sensory region, this gland, according to Peter (1902-3), cannot be homologized with the lateral gland of reptiles.

The septal gland appears, according to Schwink, in a mouse embryo with a head length of 8 mm. and in the rabbit of 68.

We see glands appear in the human embryo at the stage of from 8 to 10 cm. in the form of solid epithelial buds issuing from the internal and external walls; certain among them are provided with a small central lumen.

The organ of Jacobson appears very early (sheep of 10 mm. mole of 6). It is a furrow covered from its beginning with differentiated cells and soon is transformed into a cylindrical canal (sheep of 14 mm.) for a large portion of its extent. Towards its anterior extremity, a portion of the primitive choana (canal of Stenson) persists in order to establish communication with the buccal cavity. Placed below the septal cartilage, this organ is in relation internally and inferiorly with the cartilage of Huschke or of Jacobson. In the human embryo of 19 mm., this organ is placed above the inferior border of the septal cartilage, remote from the cartilage of Huschke (Fig. 50). This is according to the description of Dursy, Koelliker, Garnault, Mihalkovics and Tourneux. Gegenbaur, by reason of the elevated situation of this canal and its distance from the paraseptal cartilage, considers that it acts as the excretory canal of a septal gland. Garnault and Mihalkovics, on the contrary, do not admit the necessity of any relation between the organ and the cartilage. In the series of mammals, the organ of Jacobson has not always the same destiny; it grows, conserving its relations in the majority of the groups, while it disappears in certain others (Cheiroptera, man).

CHAPTER III.

GENERAL CONSIDERATIONS.

Olfactory Anlage.—The nasal cavities of vertebrates are derived from ectodermic thickenings depressed into fossettes; these close by approximation of the borders which limit them, but always preserve an external opening, at the level of which their wall is in continuity with the external layer. These are distinguished thus from identical formations; crystalline lens, auditory vesicle.

They come into relation with the digestive tube (air-breathing animals) by its ectodermic portion (buccal fossette). There are no primitive relations in any vertebrate with the entodermic layer. This fact makes it possible to refute the view of Dohrn, who considers the olfactory cavity as the first branchial cleft, inasmuch as the branchial clefts present an ectodermic and an entodermic portion in their formation.

The olfactory apparatus is distinguished from other sensory apparatuses by special characteristics. The organs of sense, with the exception of taste and the tactile sense, offer peculiarities in the disposition of the corresponding nerve system. In the auditory apparatus, the auditory nerve takes origin in the peripheral nervous ganglia (ganglia of Scarpa and Corti), placed in the neighborhood of the mucosa which perceive the sound waves. In the optical apparatus, a portion of the central nervous system is evaginated and constitutes a sensory membrane in the peripheral perceptive apparatus, viz., the retina. In the olfactory apparatus, the ectodermic cells cover the nasal depression, and are evoluted into the type of nerve cells. In the corresponding zone, the entire thickness of the ectoderm is used for the development of the olfactory organ. The olfactory cell gives origin to two nervous prolongations, the one protoplasmic (olfactory cilium) which receives the external sensations; the other, an axis cylinder which transmits them to an intermediate neuron (cells of the olfactory bulb) having the functional value of a nerve cell.

Cellular Modifications.—The differentiation of cells of the ectoderm into cells of the nasal epithelium is effected very early (Pristiurus of 7 mm., trout of the 34th day of incubation, tadpole of the toad of 10 mm., blindworm of 25 mm., parrot of 8.5 mm., sheep of 8 mm. and mole of 5 mm.).

At the beginning of development, we find the same modifications in all points of the nasal cavities; only their date of appearance distinguishes the different zones. The first cellular transformations are found in the bottom of the fossette on the internal wall and in the organ of Jacobson. They occur in the cells of the most superficial layer. The cells which begin to elongate have first a cubical form, their protoplasm becomes refractive, forming a thin and lightly colored tract of meshwork; the cellular limits are barely marked by granular borders which stain slightly with carmine; the border towards the central extremity is thicker and more depressed. The nucleus of the cells becomes basal and removed from the surface.

The cellular height is increased in the succeeding stages and the cells take on a cylindrical form; the protoplasm is less clear and refractive and of a grayish rose color. The sensory cells take on the same color as the central nervous system.

APPEARANCE OF THE OLFACTORY NERVE.—The nerve fibres which unite the nasal epithelium to the olfactory bulb appear a little later than the cellular transformations (Petromyzon of 3 to 4 mm. according to Kupffer; selachians of 13 to 14 mm, according to Hoffman; tadpole of toad of 13 mm., blindworm of 25 mm.).

The anlage of the olfactory nerve is formed by the tract of fine fibrillae, distinguished in the solid mesenchyme by their clear yellow color and by the infrequency of the cellular nuclei; these are round, some being elongated in the direction of the fibrillae. They are scattered throughout the extent of the nerve and divided from one another as in the peripheral portion of the central nervous system. The fibrillae are lost in the middle of the epithelial cells at the nasal wall and the organ of Jacobson.

RESISTANCE OF THE OLFACTORY SENSE.—No accessory organ is interposed in the nose between the external medium and the perceptive neuron.

The olfactory epithelium is protected only by its situation at the bottom of a cavity whose communication is made with the exterior only by one or two narrow orifices, valves or muscles, capable of arresting up to a certain point, the water or air current which conveys the odorous particles. But these are so subtle that it is impossible to abstract them completely. Although the sense is poorly protected, it is on the contrary very resistant and the abundance or intensity of the impres-

sions makes its study difficult. It is at the same time endowed with great resistance and extreme sensibility; association of these two qualities is possible on account of the simplicity of its structure and the high morphologic value of the cellular elements which constitute it.

Disposition of the Olfactory Mucosa.—With this simple structure, how is the olfactory apparatus arranged? It is located in a cavity forming more or less extended folds. In fish, the nasal cavity contains numerous lamellae which subdivide it into spaces, radiating and parallel to one another. The surface is greatly augmented by reason of these lamellae. The odorous particles dissolved in the water may make an impression on this large olfactory field.

The phenomenon of olfaction appears analogous to that of gustation; the existence of olfactory buds in certain groups of bony fishes certifies to the identity of the two orders of sensation. The dissolved state of the odorous particles necessitates direct contact between the water which contains them and the olfactory mucosa; diffusion must be less easy than if the substances were in a free, gaseous state. With the surface increased in extent, contact will be more certain; the increase in the surface is attained by the presence of the lamellae.

In air-breathing animals, the olfactory mucosa is located in a special region of the nasal cavity. In the lowest forms, this region is very extensive compared to the total surface of the body. It is not possible in Urodela to disinguish an olfactory and a respiratory region; likewise in Perennibranchia (axolotl), the mucosa has folds which approximate those of fish. In Anura, on the contrary, the structure is not homogeneous throughout the cavity, and the olfactory and respiratory regions may be clearly distinguished (middle and inferoexternal culs-de-sac). A similar disposition exists in Sauropsidia, but the respiratory region, in place of separating in the form of a cul-de-sac, extends into the zone subjacent to the turbinal.

In all of the other groups, beginning with the crocodiles, the olfactory surface does not extend a great distance into the cavity but it is enlarged by the presence of folds or ethmoidal turbinals. The increase occasioned by the presence of these turbinals is very marked in mammals. The olfactory surface is one and a half times larger in man and four times in the sheep, what it would be without the turbinals.

Ethmoidal turbinals of mammals and lamellae of fish have therefore the same function.

UTILITY OF THE EXTENSION OF THE OLFACTORY MUCOSA. —Is it necessary for the sensory mucosa to be very extensive to satisfy the sense of olfaction?

The organs of sense, says Lacépede, are instruments added to the body, so to speak, of the animal, without being an essential part of it; their proportions and dimensions have a relation only in accordance with the nature, force and number of sensations which they should receive and transmit to the brain. The dimensions of the eye or the ear are not proportionate to the body of the animal and their large size does not indicate functional perfection (a large eye is myopic); but the eye and ear are complex organs organized to receive adequate impressions by virtue of accessory apparatuses. Perfection of architecture excludes extension of the organ.

These conditions are not the same for the organ of olfaction. This is directly impressed by the external sensations, and it will be more apt to receive them when the sensory surface is more extensive. There is no concentrating apparatus here for the purpose of grouping and selecting sensations. It is for this reason that the size of the olfactory region gives us an idea of the development of the corresponding function. Since the odorous particles come mixed in the respiratory air, the olfactory sensations will be the more intense when a greater volume of the current of air enters in contact with the sensory surface.

Thus a positive importance is to be accorded in the relation of the extent of the olfactory with the respiratory region.

EXTENSION OF THE RESPIRATORY REGION.—The useful amplitude of the nasal cavity respecting the respiratory function depends especially on the height and width. Is it necessary that the respiratory mucosa should be increased by an architectural process? The utility of this extension is altogether secondary. In Amphibia, the respiratory cavity increases by formation of an important cul-de-sac (infero-external cul-de-sac); this process is found in reptiles, birds and mammals, in which the cavity is increased by hollowing out of fissures which are directed externally. But these present between them portion of the wall which, when the fissures are formed, form larger or smaller ridges. These ridges or turbinals increase the respiratory surface as the ethmo-turbinals increase the olfactory. The mesoderm remains passive in the formation of

the turbinals, and the active process devolves upon the nasal cavity which is enlarged. The epithelial processes sink into the surrounding mesenchyme preceding the appearance of the fissures.

The increase of the respiratory surfaces has the function of utilizing the qualities of the mucosa which covers it. This is ciliated; the vibratile cilia constitute a mechanical protective apparatus, a sort of moving brush which throws out the solid particles contained in the inspired air. The greater the extent of the surface covered with cilia, the greater will be the purification of the air.

Besides this, by virtue of the presence of the subchorial vascular lacunae, the air which is in contact with a large vascular surface, will be heated while passing through the nasal respiratory canal. The filter function of the turbinal is well shown by the disposition of the maxillo-turbinal in the badger; it is really a sponge closing the respiratory region, through the meshes of which the current of air is compelled to pass.

The mucosa, with the double function of filtering and warming the air, is protected in its turn from the action of current of air by the presence of glands, the mucous glands extracting particles and microorganisms, the serous glands causing humidity of the surface.

TURBINALS.—Turbinals exist in all classes from reptiles to man, but they vary frequently in their disposition. The respiratory may be distinguished from the olfactory; the former are disposed in the anterior portion of the nasal cavity, the latter in the more posterior.

We may classify them in the following way:

	Man.	Mammals	Birds	Reptiles
1. Valvular turbinal (external orifice)			Vestibular turbinal	
2. Respiratory turbinals (anterior)	Inferior turbinal, Agger nasi	Maxillo-turbinal Naso-turbinal	Middle turbinal	Turbinal
3. Olfactory turbinals (posterior)	Middle turbinal. Superior turbinal Bulla ethmoidalis	Ethmo-turbinal	Superior turbinal	Pseudoconcha of the crocodile.

The turbinals are complicated in two ways, by coiling or by ramifications. The inferior turbinal is especially concerned in these modifications, which are less accentuated in the naso-turbinal and the ethmo-turbinals. Strasser has established a law which regulates the disposition of the turbinals: The inferior turbinals are directed so that their lamellae lie in the direction of the current of air, their fissuration being longitudinal, while the layers of the baso-turbinal and the naso-turbinal appear directed dorsoventrally, the fissuration being in the direction of the branches of the olfactory nerve. This law cannot be generalized for, with the exception of Carnivora and Proboscidia, which have the middle and the superior turbinals cut into lamellae, the other mammals have the naso-turbinal and the ethmo-turbinals formed by simple ridges elongated from before backwards. The classification of turbinals which we have given is not absolutely exact, for the middle turbinal of man is deprived of its olfactory epithelium on its inferior surface and a part of the superior surface, and on the other hand the naso-turbinal often has olfactory epithelium at its posterior extremity.

SINUSES.—The process of enlargement of the nasal cavity which causes the formation of the turbinal creates the diverticular cavities which are disposed in the bones of the face. These diverticula increase parallel to the skull, but their orifice of nasal communication becomes narrower and they are separated so to speak from the cavity of which they are only expansions. They are the sinuses or accessory cavities.

In the amphibians, the external or inferoexternal cul-de-sac is the first step made in the way of respiratory enlargement. The sauropsidians present a small external recess and the crocodiles a very large maxillary sinus. In birds, the pneumatic spaces are numerous around the nasal cavity as well as around the entire respiratory apparatus. In mammals, the sinuses exist in all groups, but with variations in their extent and in their topography. The sinuses appear relatively late; we have seen the maxillary sinus begin in a human embryo of 47 to 60 mm., and we have met it quite large in a calf of 11 cm. The sphenoidal sinus is present in a calf of 14.5 cm.

The frontal sinus appears at the age of 7 or 8 years in man. The role of the sinuses in olfaction is absolutely nil. Odorous particles carried directly to the mucosa of the sinuses produce no impression; their lesions do not modify olfaction; the energy

of the olfactory function is not increased at the age at which the different sinuses increase and at which the frontal sinus appears.

Morphologic Value of the Sinuses.—The sinuses appear connected in their extension with the general volume of the head; it is thus that the maxillary and frontal sinuses are very much developed in herbivora which have a voluminous head extended in length in order to facilitate prehension of the food (pasturage being the process of alimentation in the natural state) and in width in order to permit the implantation of large teeth in the form of grinders. In the carnivora the teeth are powerful but slender, so the maxillary sinus is absent or slightly developed. On the other hand, the extent of the sinuses will proportionate the dimensions of the face with those of the cranium when it is voluminous, as in man for example.

Tillaux (1862), comparing the head to a vertebra, applies to its development a law according to which: "when one of two parts of a vertebra takes on a considerable growth, the other remains stationary and it acquires a relatively larger volume." So far as this concerns the head, since the skull attains large dimensions during the fetal period, the face should remain very limited. After birth, it is the face which encroaches most upon the cranium on account of the rapidity of its development. This result is achieved by the frontal and maxillary sinuses.

The ethmoidal and sphenoidal sinuses are connected in the extension of the olfactory apparatus (ethmoidal region). It is the ethmoid which requires a very large cavity to lodge it; the ethmoid cells are distinctly proportionate to the extension of the ethmoid; as to the sphenoidal sinus, it is a part of the olfactory region separated from the remaining portion of the cavity by fusion behind the primitive ethmoidal turbinal; the frontal sinuses are derived from the ethmoidal extension; according to Steiner, they are formed by the ethmoidal cells included in the frontal. Zuckerkandl does not admit that the frontal is formed from the ethmoid cells, but he considers that it is destined to contain them. The expansion of the nasal mucosa at the beginning of the development has the primordial role; later there will be an extension of the ethmoid which causes enlargement of the sinus.

Function of the Sinuses.—The function of the sinuses has been studied by numerous authors, but it is difficult to deter-

mine it definitely. Considering that in the elephant there are numerous and vast cavities which run through the bones of the cranium and of the face of this gigantic animal, it would seem that the sinuses have the function of lightening the skull, and of leaving to the disposition of the muscles very large surfaces for insertion corresponding to the muscular forces necessary.

In résumé, the accessory cavities at the beginning of their formation are destined to increase the respiratory region (maxillary sinuses) and the olfactory region (sphenoidal sinuses, ethmoidal cells and frontal sinuses). The ultimate growth, connected with the volume of the head, permits the extension of the osseous surfaces and the diminution of their weight.

They have, besides this, secondary functions. De Meyer (1885) explained how they served to warm the inspired air. According to Couetoux (1891), they have an important action in modifying the deformative effects of aspiration. According to De Cyon, the mucosa of the nasal cavities and perhaps of the frontal cavities have a function in the phenomenon of orientation at a distance. They have the function of a resonating chamber in the phenomenon of phonation; their favorable influence in phonation has been accepted by Spigen, Bartholin, Fallopius, Ingrassias, Lieutaud, etc.

They contribute the production of harmonic sounds which characterize the timbre of the voice. Their influence is very clear if one examines the voice of a soprano, and of the falsetto, which differ from one another only in the timbre. The former appertains to women whose face is very small, sometimes even small in relation to the stature and corpulence; falsettos, on the contrary, have a large and high face with pure but clearly marked lineaments; the frontal and maxillary sinuses contribute very decidedly in establishing these differences of conformation.

Organ of Jacobson.—The olfactory apparatus is enlarged in several groups of vertebrates by the formation of a sensory organ independent of the nasal cavity from which it has its origin (the organ of Jacobson). In the amphibian Anura, it constitutes a groove, deep and much extended antero-posteriorly, which throughout its length communicates with the nasal cavity and reaches posteriorly to the choana.

In the sauropsidian reptiles, the organ of Jacobson attains its maximum of development; it is an evagination of the nasal

cavity, originating from the inferior border of the internal wall, detached early (3 cm. stage of the blindworm) from the nasal wall so as to be transformed into a canal which communicates directly with the buccal cavity.

In the crocodiles and chelonians, this organ exists only during embryonic life; in adult birds, it is entirely absent and we cannot be sure of its existence in the embryonic anlage.

It reappears in mammals and is well developed except in primates; it is absent in the human adult. Its communication with the buccal cavity is formed by the intermediation of the nasopalatine canal.

What is the significance of this organ?

According to Cuvier, it is destined to distinguish useful alimentary particles from those which are not. According to Koelliker, it serves to recognize the chemical composition of the body juices. Seydel accords to it the function of sensory control of the expiratory current. Mihalkovics refutes these different views and claims that this organ is designed to perceive the genital odors and for this reason it is well developed in crawling animals and absent in birds and fish, which are accommodated by their visual apparatus, and atrophied in man on account of the development of the intelligence.

It appears to us more reasonable to consider it as related to the function of taste. Its communication with the buccal cavity justifies this function; on the other hand, it is absent in birds in which the buccal cavity communicates with the olfactory region by the long choanal fissure. It must have a function in the selection of food rather than in the appreciation of taste, for it is developed at the maximum in snakes, animals which do not linger to enjoy their food.

We recall, therefore, the old theory of Cuvier.

Phylogenetic Relations Between the Different Vertebrates.—There are two aberrant groups at the bottom of the scale of vertebrates: Cyclostomes and Amphioxus.

The latter is clearly monorrhinal and the olfactory fossette is united in its formation with the hypophisial diverticulum.

The cyclostomes are parasites in which the whole face is occupied by an immense, circular mouth. The olfactory organs are pushed back upon the dorsal surface and are fused in the middle line. The enormous extension of the superior lip (or more exactly of the superior border) forces the nasal organ to move back upon this dorsal surface and to be placed near the neuropore.

The primitive amphirrhinia is indicated by the duplexity of the olfactory nerve. These animals have been amphirrhinal and it is not necessary that the other vertebrates should have been primarily monorrhinal (at least this is not demonstrated by any other group). The amphirrhinia is normal and primordial while the monorrhinia is regressive.

Certain cetaceans appear to be monorrhinal on account of the imparity of the blow-hole. This only appears so, for both cavities end in common in a sac and in a vestibule conducting it to the external orifice. In the cetodonts, in which the skull is asymmetrical, the nasal fossae participate in this deformity: one of the nasal fossae (the right in the cachelot) opens now only at the level of the nares, being atrophied. The left naris gives rise to the blow-hole and by secondary connection, the right nasal cavity opens into that of the left side. It is for this reason that the orifice of the blow-hole is deviated to the left. There can be no question of nasal imparity in this case. The nasal fossae, according to Abel (1902), have a very important function in the deformity of the skull of the cetaceans (Odontocetes), in which the asymmetry is so much more manifest when the nasal cavities pass further back towards the cranium.

Asymmetry is found in man under the form of septal deviations; this appears about the age of 7 or 8 years or later; it is caused by an exaggeration of the asymmetry of structure under the influence of nasal inflammations.

The group of water-breathing vertebrates is connected with that of the air-breathing vertebrates by the lower amphibians (Proteus and Axolotl); the Axolotl, having a naso-buccal orifice, presents folds of the nasal mucosa which approximate the nasal orifices of fishes.

GENERAL RESUME.

The study of the olfactory apparatus suggests to us the division of the vertebrates into two great classes: I. Water-breathing, and, II. Air-breathing.

MORPHOLOGY.—I. The olfactory apparatus of water-breathing animals is disposed in a cavity opening externally, which it occupies in toto. The cavity may be single (1) or paired (2). (1) The single cavity is found in amphioxus, in which it forms a simple, ciliated fossette placed upon the left side of the anterior extremity of the animal, and in the cyclostomes in which it lies in the median line of the dorsal surface, immediately in front of the cranial capsule. It opens externally by a single orifice, infundibular (Ammocoetes) or carried on a small membranous tube (Petromyzon). Below and behind, the cavity is prolonged into a canal terminating in a cul-de-sac on the superior wall of the digestive tube (Petromyzon) or even opening into the latter (Myxine). The cyclostomes, in spite of the imparity of their nasal organs, possess two olfactory nerves; furthermore, in the Ammocoetes, an incomplete median septum (dorsal lamella) divides the cavity into two symmetrical halves.

(2) The double cavity belongs to the selachians, teleosts and ganoids. It opens externally by an orifice, single (selachians) or double (teleosts and ganoids). The single orifice of the selachians is functionally divided into two by a valve prolonging its anterior border. The disposition of the two orifices in the teleosts is variable: one of these, the anterior, is formed by a valve or carried on a small tube and closed to the exit of the water. The other posterior is freely opened, and closed to the entrance of the current. The nasal cavity is enveloped by a cartilaginous capsule (selachians), hollowed in the cartilaginous framework (ganoids), or lodged in bony interspaces (teleosts). In the latter case, there are large, squamous bones which circumscribe the interspaces.

The nasal organ of all water-breathing animals (with the exception of Amphioxus) is constituted by a fibrous sac in which the mucosa is exposed. This is folded and forms lamellae disposed in a radial way (cyclostomes, ganoids and numerous teleosts: barbel, trout, gurnard, etc.), or ranged on two sides of an axis (selachians, eel, etc.). The epithelium, formed of two orders of element, one epithelial, the other olfactory, is

homogenous throughout the nasal cavity (cyclostomes, selachians, ganoids and numerous teleosts: eel, conger, carp, tench, trout, etc.) or shows small buds (olfactory) analogous to the taste buds and containing all the olfactory cells (belone, gurnard, pike and char, etc.).

II. The olfactory apparatus of air-breathing animals is disposed in a cavity opening externally and into the digestive tube. It occupies the entire extent of the cavity, uniformly (3), or it is localized to a particular region of this cavity of considerable extent (4), or is relatively restricted (5).

(3) The entire extent of the nasal cavity has the same structure; there is no distinction that can be made between the olfactory and respiratory regions (amphibian Urodela and Perennibrancha). The mucosa in the latter animals (Proteus, Axolotl) presents some folds comparable to the lamellae of fish. The group of Perennibrancha establishes the transition between groups I and II.

(4) In the nasal cavity, the olfactory region may be distinguished from the respiratory; the olfactory, characterized by thickness of the epithelium and the presence of sensory cells, covers a large extent of the walls of the cavity; it has no architectural peculiarity (Anura, Sauropsidia).

The other region, the respiratory, is subjected to a decided extension, as the nasal cavity becomes an important air passageway. This extension is effected by the formation of culs-de-sac in relation to the choanae (Anura) or by the appearance of a parietal ridge, a turbinal, which increases the surface of the mucosa (Sauropsidia).

(5) The nasal cavity constitutes a very important air passageway and the olfactory region is very much restricted, but its surface is enlarged by a false turbinal (crocodiles, birds) or by numerous ethmoid turbinals (mammals). This olfactory region is characterized by its sensory structure and its relations to the olfactory nerve. The respiratory region, much extended, is increased by the presence of turbinals and accessory cavities. It has an investment of cylindrical, ciliated epithelium and numerous glands. The external orifice opens at the level of the skin on the dorsal surface of the snout or beak (reptiles, birds, ornithorhyncus) or on a special ridge of the face, the external nose, variable in its disposition (mammals). This orifice is single in a large number of cetaceans and asymmetrical in the cetodonts; atrophy of one naris and secondary opening of the corresponding cavity into that of the side opposite

explain this abnormal disposition. The internal orifice, or choana, opens on the buccal roof (amphibians, saurians), in a furrow of the buccal roof which is common with that of the opposite side (ophidians), in the form of a long palatine fissure (birds) or into the pharyngeal cavity (mammals).

The olfactory apparatus is enriched by a specially differentiated region, detached from the nasal cavity and connected in function with gustatory appreciation, utilized especially for the selection of food; this is the organ of Jacobson. a simple longitudinal furrow opening into the choana (anurans), or a cylindrical canal in communication with the buccal cavity, either directly (sauropsidians) or through the intervention of the nasopalatine canal (mammals). This organ is wanting in the crocodiles, birds and man.

The nasal cavity is protected by a cartilaginous envelope in amphibians, reptiles and birds. The bony skeleton forms a very incomplete boundary of this region in the anurans, reptiles, and birds, while in the urodeles and in mammals the walls are very extended.

The submucosa is characterized in mammals by the presence of vascular tissue capable of becoming turgescent, like erectile tissue.

Embryology, I.—(1) In the cyclostomes, from the beginning of development, the olfactory outline is constituted by an epithelial mass placed between the dorsal ectoderm and the anterior extremity of the neural tube (Petromyzon embryos of 4 and 6 mm.). The parity of the olfactory organ is indicated by the duplexity of the olfactory nerve and the presence of a median lamella in Ammocoetes. It is by the enormous development of the buccal orifice and especially the extension of its superior border, that the nasal organ reaches back in contact with the nervous system. The development of the mesoderm on the lateral portions approximates the two outlines to one another and unites them at the level of the neuropore.

I (2) and II.—In all animals with a double nasal organ, it takes its origin from the ectoderm, which is thickened into a lateroventral zone placed below the inferoexternal angle of the neural tube. This outline becomes ventral (selachians) or dorsal in the course of evolution (bony fishes, amphibians, reptiles, birds, mammals).

All the layers of the ectoderm are employed in the development of the olfactory organ: the first proof is taken from the precocious differentiation of the superficial layer of the ecto-

dermic thickening into sensory cells; the second from the presence, in the deep regions of the nasal walls of the amphibians, of pigmented cells which originally belonged to the external layer of the ectoderm.

The hollowing out of this thickening transforms it into a fossette; this, in the amphibians, grows directly into the surrounding mesenchyme; its ventral wall sends out a thick epithelial bud which reaches the buccal epithelium posteriorly. The nasal lumen penetrates into this bud and forms the inferior cul-de-sac upon the greater portion of its extent and the choana at the level of its posterior extremity. In reptiles, birds and mammals, the fossette is prolonged backward in the form of a furrow. The fusion of the surrounding mesodermic masses (nasal and maxillary buds) forms a ventral wall, closing thus the fossette and furrow for a considerable length (primitive palate) and leaving only two orifices, one anterior(external nasal orifice), the other posterior (primitive choana or palatal cleft). In mammals, this cleft is closed at the beginning by the bucco-nasal membrane, and opens only secondarily into the buccal cavity. This latter enters into the constitution of the definite nasal cavity at the period at which it forms the secondary palate. The epithelial budding of the external wall and the fissuration of these buds bound the region of the ridges which become the turbinals (reptiles, birds, mammals).

The very great extension of one of these fissures ends in the formation of the maxillary sinus.

The development of the ethmoid turbinals and their fusion behind separate from the nasal cavity a region which becomes the sphenoid sinus; the extension of the ethmoid anteriorly provokes the appearance of the frontal.

At a very early period of development, a furrow like evagination of the internal surface of the nasal cavity forms the beginning of the organ of Jacobson (reptiles, mammals, man); this region is the site of cellular differentiation from the time of its appearance.

The growth of the nasal cavity in its anterior portion (vestibular region) is effected by fissuration of a solid epithelial mass (epithelial button) which is quite long and is situated between the external orifice and the anterior extremity of the turbinals (reptiles, birds, mammals, man).

The glands appear late.

The skeleton is primarily cartilaginous, it surrounds the cavity and furnishes an axis for each turbinal. In the superior

turbinal of birds, the cartilage of the external wall forms only a simple fold instead of an axial lamella.

The cartilaginous envelope persists in this state in amphibians, reptiles and birds and remains independent of the bony skeleton; in mammals, it is subjected to the phenomena of ossification and is united to the facial skeleton.

The date of appearance of the different elements of the nasal apparatus is indicated in the following table:

TABLE OF BEGINNING OF THE DIFFERENT ELEMENTS OF THE NASAL APPARATUS.

	Cyclostomes	Selachians	Teleosts	Amphibians	Reptiles	Birds	Mammals	Man
Olfactory Outline.	Petromyzon of 4 mm.	Pristiurus of 5 mm.	Salmon trout, 34th day of incubation.	Tadpoles of toad and frog of 4 mm.	—	Parrot of 5 mm.	Mole, 4 mm. Guinea-pig 5 mm. Sheep, 8 mm.	—
Sensory Cells.....	—	Pristiurus, 7 mm.	Salmon trout, 34th day of incubation.	Tadpoles of toad, 10 mm.	—	Parrot, 8.5 mm.	Mole, 5 mm. Sheep, 8 mm.	8 mm.
Primitive Palate..	0	0	0	0	—	Parrot, 6.5 mm.	Mole, 7 mm. Sheep, 10 mm.	8 mm.
Secondary Palate..	0	0	0	0	—	—	—	47 to 60 mm.
Turbinals.........	—	Mucous folds, Pristiurus, 12 mm.	Mucous folds, rainbow trout, one month.	0	Blindworm, 25 mm.	Parrot, 11 mm.	Mole, 9 mm. Sheep, 15 mm.	19 mm.
Sinuses...........	0	0	0	0	—	—	Maxillary sinus, Calf, 11 cm.	47 to 60 mm. (Maxillary sinus)
Organ of Jacobson.	0	0	0	Toad with 4 feet and long tail.	—	0	Mole, 6 mm. Sheep, 10 mm.	19 mm.
Olfactory Nerve...	Petromyzon, 3.5 mm.	13.5 mm.	—	Toad, 13 mm.	Blindworm, 25 mm.	—	—	—
Glands...........	0	0	0	Toad with 4 feet and long tail.	Blindworm, 7 cm.	Chicken, 8th day of incubation	Sheep, 13.5 cm.	80 to 100 mm

0 Indicates absence of organ.

— Indicates no observation made by us.

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XLIV.

SURGICAL TREATMENT OF TUBERCULOSIS OF THE UPPER AIR PASSAGES AND THE EAR.

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No subject in medicine possesses a more extensive or interesting history than tuberculosis, nor can any disease boast of more attempts at solving the problem of its treatment with less permanent, definite and satisfactory results. Still out of the mass of suggestions for more or less radical lines of action, it cannot be denied that progress has been made and that many cases are cured, many more are improved and a large number is given an increased and comfortable longevity. This is true of tuberculosis generally, but it is particularly so of tuberculosis of the upper air passages. To go back more than a few years into the history of the treatment of this affection is only of literary interest. The only practical result which followed the enthusiastic advocacy of innumerable remedies and methods of treatment was an occasional valuable advancement. By the errors of overenthusiasm, however, we have profited to the extent of being better able to denitely and intelligently apply certain modes of treatment, and in no field of our science is this more marked than in the surgical treatment of tuberculosis of the throat, nose and ear.

It cannot be claimed that the extravagant hopes of the fathers of the operative management of tuberculosis of the upper air passages have been fully realized, but the twenty years which have passed since Krause,[1] 1885, and Heryng,[2] 1886, promulgated their views have unified to a great extent the views of laryngologists, and the pendulum is now swinging near a more rational plane. The name of Herman Krause is indissolubly associated with the lactic acid treatment of tuberculosis, and that of Heryng with operative measures. These two methods have, however, always been closely associated, and consequently the Krause-Heryng method covers more nearly the surgical treatment.

Included in this term, so far as the upper air passages are concerned are, first, deep incisions; second, curettage; third, excision; fourth, galvanic cautery; fifth, tracheotomy;

sixth, laryngectomy. So far as the ear is concerned, operative treatment includes the same measures that are applied to chronic suppurative processes of non-tuberculous origin. These surgical procedures have, however, certain limitations which are always largely controlled and modified by the character of the lesions, their nature, extent and complications, and also by their primary or secondary development. Thompson states that "we must look elsewhere at present than to surgical measures for a prospect of progress in the treatment of tuberculosis of the larynx. This progress is ready to hand in the making of an earlier diagnosis of local infection."[3] The early diagnosis, therefore, adds another extremely important limitation to the surgical management of these cases. This is true not only of the larynx, as Thompson announces, but it applies as well to the ear.

Tuberculosis of the Ear.—This may be considered as a form of chronic suppurative otitis media with possibilities of all the complications with which we are familiar. Its nature differs in that its attack is slow, insidious and attended at times by very extensive destruction, due in large measure to the lowered resistance of the tissues. All cases of chronic suppuration of the middle ear in tuberculous individuals must not be considered tuberculosis, but whether tubercle bacilli are found or not does influence the indications for surgical measures. The vast majority of suppurative processes in the middle ear occurring in tuberculous patients do not go on to destruction of bone; therefore, surgical measures have but limited usefulness. Politzer[4] advises operation for tuberculous diseases of the petrous bone when pulmonary tuberculosis develops in the course of a long standing suppuration of the middle ear, while he advises against operation when the disease of the bone comes on in the course of a well-established pulmonary lesion. Milligan[5] advises operation when the extent of the disease is not too great and the general condition of the patient not too hopeless. The objects to be obtained are the removal of all available foci of the disease and the establishment of efficient drainage. These two views should form a basis upon which to build our indications for treatment.

Given a patient whose general condition is fair, whose temperature and pulse do not indicate rapidly progressing disease, whose hygienic, sanitary and social surroundings are

favorable and whose ear lesion consists in destruction of bone, an attempt should be made to remove it by surgical measures. The nature of the operation will depend upon the site and extent of the lesion. If ossiculectomy will suffice it should be performed, followed by careful curettage and the application of lactic acid and antiseptic irrigation. If the mastoid be involved, a radical operation is indicated. Under all circumstances the two important considerations to be borne in mind are the removal of diseased bone and the establishment of free drainage.

Tuberculosis of the Nose.—This is of rare occurrence. It is usually seen in the form of ulcerations or new growths, so called tuberculomata. When seen early, surgical measures are followed by surprisingly good results. Ulcerations should be thoroughly curetted and lactic acid freely applied. Tuberculomata should be removed by the cold wire or galvanic cautery snare. This should be followed by thorough curettment, after which lactic acid should be freely applied. The nose responds more satisfactorily to surgical treatment in these cases than any other portion of the upper air passages. This is due to the fact that tuberculosis of the nose is seen early, that the lesion is usually limited and that it occurs as a manifestation of the more chronic forms of the disease unattended by high temperature and rapid pulse.

Pharyngeal Tuberculosis.—As a rule, all the conditions which contraindicate surgical intervention in tuberculous processes exist when the pharynx becomes involved. The disease is a manifestation of a rapidly progressing, acute process. It is associated with high temperature and rapid emaciation. It accompanies the most asthenic form of tuberculosis. Its local manifestations are scattered and spread rapidly and widely. When we see a solitary circumscribed ulceration in any portion of the pharynx in a tuberculous individual, it is well to question its tuberculous character. In the writer's judgment, the curative value of any surgical procedure for tuberculosis of the pharynx is so limited that it may be practically discarded. As a palliative remedy, operative measures possess some virtue.

The particular forms of surgical intervention that are applicable are curettage and galvanic cautery. After thoroughly cleansing the ulcerated surface and applying 20 per cent cocain solution, the galvanic cautery or the curette may be

freely used. The writer prefers to do as much at one sitting as possible. The after-effect may be rather severe for a few days, but not much more so if a large surface is operated upon than if the surface is limited. The relief to pain is usually sufficient to justify the procedure. The shock to the patient is moderate and is distinctly less than when frequent operations over small areas are performed. The rationale of surgical measures where only palliative results can be expected depends upon the histological research of Danzac,[6] who found that the pain in tuberculous ulcerations was due to a "proliferation of the terminations of the peripheral nervous filaments—a veritable neuroma of regeneration." By destroying this proliferation or nervous tumor, much of the sensitiveness is relieved.

Laryngeal Tuberculosis.—This is the most common complication of pulmonary tuberculosis, and in as much as primary lesions of the upper air passages are extremely rare, if they ever occur, laryngeal tuberculosis is the form that has more generally attracted our attention. It occurs early and late in the disease, is attended with symptoms barely noticeable, as well as of such severity that the laryngeal complication is the most important manifestation of the disease. When, therefore, Krause and Heryng advocated so strenuously and with such a good showing surgical treatment, this method was hailed with delight and applied heroically and with great radicalism. Time, however, has shown that like all other remedies, operative intervention in laryngeal tuberculosis has its usefulness, but also its abuses. Each form of surgical procedure has its particular advantage.

Deep Incisions.—This procedure is particularly useful when there exists pronounced edema or extensive, uniform, smooth infiltration. The value of incisions in edema is seen in marked shrinking of the swelling and relief in many instances, to difficult, not necessarily painful delugtition and to respiratory distress. In cases of uniform, pale, more or less firm infiltration, deep incisions are principally useful as an auxiliary measure to the thorough application of lactic acid. In this connection one might refer to the submucous injections of lactic acid, creosote and other preparations, as advocated by Major,[7] Chappell[8] and others. Such injections, however, are but mild imitations of deep incisions followed by friction with lactic acid.

Excision.—This is a true surgical manipulation and is an ideal method of operating upon tuberculous deposits. As such, its application is limited to those cases in which there is a certainty or a strong probability of completely removing the entire focus of disease. It is here, however, that we must face the most discouraging feature. The diagnosis is rarely made so early that a limited involvement of tissue, well circumscribed, manifests itself. The character of the lesion as well as its early recognition also offers an opportunity for this surgical measure. The true tuberculous tumor is frequently and fortunately among the earliest laryngeal manifestations.[9] It is more likely to be well localized and is readily extirpated. The infiltrative or hypertrophic tuberculous manifestation usually invades surrounding structures to such an extent that its extirpation would be a practical impossibility. Not infrequently, however, the epiglottis or a portion of the epiglottis is the principal laryngeal involvement. The tuberculous focus may be, in this instance, satisfactorily removed, the healing being often prompt and gratifying. However, one must be fairly certain that the tuberculous process is expending itself upon the epiglottis and not also upon contiguous structures, and too much stress cannot be laid upon the necessity of repeated and most careful laryngoscopic examination before an operation is undertaken. Even then it is in many instances absolutely impossible to determine the extent of the infiltration. Two specimens that I present herewith are good examples of two extremes. The first specimen is that of a well-defined circumscribed tumor which was located in the posterior commissure. Its removal was easily accomplished, and so far as the larynx is concerned the patient had no further trouble. The section as shown by the microscope confirmed the diagnosis showing the presence of numerous tubercle bacilli in the tissue. The second specimen shows extensive tuberculous infiltration and ulceration of the epiglottis, aryepiglottic folds, the arytenoids, the interior of the larynx and the subglottic region. A section taken from the trachea shows abundant tubercle bacilli in the tissue. This illustrates the difficulty and, in fact, the impossibility of determining the extent of the lesion microscopically. One would, of course, not advise the extirpation of so extensive a lesion as is seen here, but the conclusion is forced upon us that even though the infection involve a mod-

erate portion of the larynx, the naked eye cannot detect its extent when we consider how far in advance of the apparent lesion the infection in this case was found.

Curettment.—This procedure is probably the most frequently applicable of all surgical measures. It is indicated in ulcerations and soft excrescences. Tuberculous ulcerations may be classified into acute or active, and chronic or sluggish ulcerations. The acute ulcerations are usually associated with marked edema, extensive involvement of surrounding structures, high temperature and other manifestations of great activity in the tuberculous process. Curettage is here contra-indicated. On the other hand, the form of ulceration which is sluggish, localized, attended with no marked edema or constitutional evidences of rapidly progressing disease, respond promptly to this surgical intervention. After thoroughly curetting, lactic acid or Lake's formula, of formalin, lactic acid, carbolic acid and glycerin, should be thoroughly rubbed into the parts. Healthy granulations are soon seen and the cicatrization of these ulcerations is a common result. Other ulcerations may develop and may be treated likewise. Repeated and extensive operations of this kind may thus be performed as various new ulcerations develop. Frequent cures have been reported, notwithstanding the involvement of much of the laryngeal structure. The salvation of this class is in the fact that the extensive involvement is not found at one time, but is developed progressively, each new development being met by the same radical surgical measure.[10] Thoroughness in this manipulation is essential. The curette should be strong, sharp and at the same time so delicately constructed that it may be applied to any portion of the larynx with ease. To meet these requirements I have for years used the accompanying instruments with much satisfaction. The soft papillomatous excrescences so frequently seen in laryngeal tuberculosis are readily removed by the curette. If, however, they are of a large size, Krause's laryngeal forceps may precede the curettage.

Galvano-Cautery.—This is an extremely useful method of bringing about cicatrization of small, easily accessible tuberculous ulcerations. It should not be used indiscriminately, nor can it be as extensively applied as the curette. The serious reaction following its use need only be feared where it is too vigorously and too extensively used.

Tracheotomy.—Notwithstanding an occasional, sporadic, enthusiastic advocacy of tracheotomy for the cure of tuberculosis of the larynx, it has never been accepted by the majority of laryngologists. Schmidt, I believe, still advocates placing the larynx at rest by this method, and its virtue was well demonstrated in a case of most extensive tuberculous disease of the larynx reported by McIntyre. It would seem that this operation might be justified upon rational grounds, but the dangers from the usual complications following tracheotomy, such as increased bronchitis and pulmonary irritation, must always be sufficient to deter one from accepting tracheotomy as a routine measure. It may possibly be of more value in children, as recently suggested by Finder.[11] His recommendation is based upon the difficulty with which intralaryngeal manipulation may be carried out in children. A number of years ago I tracheotomized a child for multiple papillomata of the larynx. The tracheotomy tube was retained for a considerable period of time during which the papillomata were being gradually removed. The child developed tuberculosis and died within a very short time thereafter. It always seemed to me that the tracheal opening favored pulmonary infection and assisted its rapid progress.

Laryngectomy.—This operation, partial or complete, will probably always be considered inadvisable in tuberculosis. So dangerous a procedure can only be considered when the disease is definitely localized. At such a time intralaryngeal methods are of quite as much avail and are not attended with the same dangerous possibilities.

SUMMARY.

First. The views of the majority of laryngologists regarding the surgical treatment of tuberculosis of the upper air passages have been unified in the past twenty years.

Second. Surgical measures are controlled by the character of the lesions, their nature, their extent and other complications, whether primary or secondary, and by the limitations placed upon the possibility of early diagnosis.

Third. All cases of chronic suppuration of the middle ear in tuberculous individuals are not necessarily tuberculous.

Fourth. The objects of surgical measures in tuberculosis of the ear are the removal of all available foci of disease, the

removal of diseased bone and the establishment of free drainage.

Fifth. Tuberculosis of the nose responds readily to surgical treatment, the methods used being curettment and excision by cold wire or galvanic cautery snare.

Sixth. Pharyngeal tuberculosis is a manifestation of the most asthenic form of the disease, presenting all conditions which contraindicate surgical intervention.

Seventh. Operative measures in pharyngeal tuberculosis are only of palliative value.

Eighth. In laryngeal tuberculosis, deep incisions are valuable in edema and in uniform, firm infiltration, their usefulness being increased by rubbing with lactic acid.

Ninth. Excision of tuberculous deposits is limited to those cases in which there is a certainty or a strong probability of completely removing the entire focus of disease.

Tenth. The extent of the involvement is often greater than can be determined by laryngoscopic or microscopic examination.

Eleventh. Curettment is valuable in ulcerations and soft excrescences. The character of the ulceration modifying, however, its applicability.

Twelfth. Repeated and extensive operations may be performed provided the lesions develop progressively.

Thirteenth. Galvanic cautery is useful in small, easily accessible tuberculous ulcerations.

Fourteenth. Tracheotomy may prove of value in children and is always indicated for the relief of dyspnea.

Fifteenth. Laryngectomy is probably never indicated.

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ABSTRACTS FROM CURRENT OTOLOGIC, RHINOLOGIC AND LARYNGOLOGIC LITERATURE.

Examination of the Stuttering Among the School Children in the Netherlands.

DR. G. H. MULDER reports an examination made by the committee of the Netherlands Laryngological, Rhinological and Otological Society (*Tydschr. v. Geneesk.*, April 28, 1906). Twelve members of the society participated. The principals of the schools filled in blanks with 13 questions. Of 68,914 children, 745 were stutterers, that is 1 per cent; of the 36,260 boys, 599 were stutterers, that is 1.64 per cent; of the 32,654 girls there were 146 or 0.44 per cent. Of the total of the stutterers, 80.4 per cent were boys and 19.6 per cent were girls. Mulder considers that this difference of the sexes favors a hereditary explanation, as is found in hemophilia and color-blindness. The smaller number of the stuttering girls argues against psychical infection, as the female sex possesses more the gift of imitation willingly or unwillingly. The age is given in 526 of the 745 stutterers. The only conclusion in regard to the grade in which these children were is that we do not find a large increase in frequency during the school years. Stuttering began in most of the cases before the sixth year; of 446 stutterers, 187 began before they were 3 years old and 108 before they reached the age of 6. This also in favor of a hereditary tendency or congenital defect, and seems to presuppose a localized defect in the central nervous system or in some center or in the mutual connection of the centers. The question "do more stutter in the family" was answered very differently and insufficiently, still in 216 of the 526 cases the answer was positive. The general conditions did not give an opportunity for specific observations; only one examiner found 53 of his 88 cases "scrofulous." Of the 523 children examined, 221 suffered from a restricted nasal breathing, through deviation or thickening of the septum, or adenoids (the large majority, some 40 per cent), or through enlarged tonsils, or through combinations of these.

Three degrees are distinguished: 1. Those in which the defect is very troublesome and is constantly present, so that these children can do no errands (90 of the 407 stuttering boys=22 per cent; 12 of the 88 girls=13.5 per cent).

2. Moderate, in which the defect is only now and then very strong, but generally little troublesome (147 boys=36.5 per cent; 27 girls=31 per cent). 3. Slight, in which there is little or no trouble (170 boys=41.5 per cent 49 girls=55.5 per cent). Boys and girls combined, 102=22.6 per cent belong to the first group, 174=35 per cent to the second, and 219=44.4 per cent to the third. Among the second group, many will be found who will suffer in the school or later, so that it is no exaggeration to state that one-fourth or perhaps one-third of the total number of stutterers will need help. In the family of at least 40 per cent of the stuttering children two or more were found; these were mainly brothers or sisters, but in many cases the father or mother as well. The percentage of children who have stutterers in their family is still much larger. In the large majority, a distinct nervous predisposition can be demonstrated. On account of this and other mentioned facts, stuttering can be considered due to a hereditary predisposition. The so-called accidental causes have a subordinate significance. A high percentage of backward children is found among stutterers. Although a general retardation of the intellectual development could not be stated, still in stutterers, more than among the entire school population, children were found who are two or more classes behind.

The number of cases is not sufficient to show a strong connection between stuttering and left-handedness; some facts, however, warrant a later investigation.

Blaauw.

The Treatment of Hay-Fever.

PROF. W. KOSTER (*Tydschr. v. Geneesk.*, May 19, 1906) had little success with Dunbar's serum. Koster is more and more convinced that contamination with pollen of the graminae is still the direct, but not the real, cause of this odd affection. It must be concluded that there is some change in the individual when he has been free until his thirty-fifth year and then acquires these symptoms after contact with pollen, which disappear after removal from this contact. His attention became directed to the chronic changes of the mucous membranes which are found with so many sufferers of hay fever, the so-called "dry" inflammations of the mucous membranes of the eye, nose and throat. Contact with pollen produces

in healthy people increased production of mucus; the mucus partly envelops the pollen with an impenetrable layer and, as far as it covers the membrane with an invisible layer, makes it impossible for the pollen to have any influence on the layer of nerves and blood vessels. This reaction does not take place in the patient with "dry" inflammation; his mucous membranes are or become duly moist but not mucous. The consequence is that the pollen may exhibit its irritating action. Koster recommends the potassium chlorate, which has a soothing action in chronic pharyngitis, as it produces a clear, somewhat sweet mucus. He uses it in the following way: As soon as the irritative symptoms commence or should begin, that is about the middle of May, one must gargle the throat well with a 3 per cent solution, then irrigate the nose by pouring this same solution into it with a teaspoon, and when the fluid is snuffed up well, spit it out, and then the eyes are treated with an eye bath. This should be repeated three times a day. During the treatment smoking is not allowed, and it is not advisable to use stimulating drinks, especially alcoholic. The patient should keep away from dust and should walk very little in the country; when the nose, throat or eyes itch, menthol should be snuffed up, till the irritation has disappeared, also after an attack of sneezing. One has to be careful in not "catching cold," as every affection of the mucous membranes operates in favor of the hay fever. Koster uses sometimes insufflations of 100 to 200 mgr. of potassium chlorate powder in the nasopharyngeal cavity. It may irritate the mucous membrane of the nose and throat at first, but only for a few minutes, and the next time the patient hardly feels anything. The patients must be carefully instructed not to swallow it, and care should be taken that not too much is resorbed, as otherwise nephritis and renal hemorrhage may follow. Children should learn with a 1 per cent solution of sodium chlorid. The seashore is excellent when there is a sea breeze. The trouble is increased by sunshine and land breeze. Hay fever can be combated in three ways:

1. By preventing contact of the pollen of the graminae (and most probably of other pollen) with the sensitive person.

2. By making the person immune with serum, as described by Dunbar.

3. By treatment of those mucous membranes on which the pollen acts, so that they have their normal means of defense.

Blaauw.

The Course of the Sigmoid Sinus in the Child's Skull.

RUDLOFF, Wiesbaden (*Archives of Otology,* Vol. XXXV., No. 2). Macewen's guide for determining the course of the transverse sinus in the adult is by connecting the deepest part of the parietal incisure of the temporal bone with the mastoid; this line describes the middle part of the venous sinus, sometimes its posterior part on the left side, frequently its anterior margin.

The author found in the child the anterior margin of the sigmoid sinus is situated at a varying distance posterior to Macewen's line.

I. At a level of the root of the zygomatic process, the distance is:

1. In the new-born, 6 mm.
2. In a child 1 year of age, 6 mm.
3. In a child between 2 and 3, 10 mm.
4. In a child of 6, 3 mm.
5. In a child between 9 and 10, 7 mm.

II. At the level of the parieto-mastoid suture, the distance is still greater.

1. In the new-born, 7 mm.
2. In a child 1 year of age, 10 mm.
3. In a child between 2 and 3, 17 mm.
4. In a child of 6, 6 mm.
5. In a child between 9 and 10, 16 mm.

The distance is greater, the broader the mastoid process. In the new-born the groove in the temporal bone is so shallow as to be hardly recognizable. It grows, however, and at the seventh year resembles a half-cylindric groove, while the mastoid process extends somewhat backward. As the groove becomes deeper, the sinus travels forward so that its anterior margin in the course of years gradually approaches and passes beyond Macewen's line. *Campbell.*

A Congenital Fibrolipoma of the Palatal Tonsil.

ZOLKI, Strassburg (*Archives of Otology,* Vol. XXXV., No. 2). Benign tumors of the tonsils have rarely been observed.

The mother state that, in a child of 7 years, she observed a tumor in the throat shortly after birth. For the past four years there has been a disturbance in swallowing. On examination, a large smooth, pale red tumor, 30 mm. in length and 11 mm. in breadth and thickness, is seen attached by a narrow pedicle to the upper part of the left tonsil.

The tumor consists of connective tissue traversed by numerous blood vessels and is covered by several layers of pavement epithelium, which become horny in the superficial layers. The tumor's most unusual feature is an area of lymphatic tissue, 5 mm. in diameter, at a point farthest away from the tonsil, which contains follicles—in fact, looks like a piece of tonsil. *Campbell.*

Otitis Interna Sinistra Hemorrhagica.
Vicarious Menstruation.

AMBERG, Detroit (*Archives of Otology,* Vol. XXXV., No. 2). A woman, aged 33 years, in whose family there is no deafness and who had had no prior trouble with her ears, on an August afternoon took a very hot bath, in which she remained 20 minutes. Afterwards, stooping forward and throwing her hair over her head to comb it, she became so dizzy and nauseated on again assuming the erect position that she had to lie down for one and one-half hours.

She had just gotten over her normal, scant, three-day menstruation. On the following day, she noticed a noise in the left ear like escaping steam. The nausea persisted for three days. The dizziness lasted two and one-half months.

Hearing by watch—right ear, $^{72}/_{100}$;
left ear, $^{1}/_{200}$.

Hearing by low tuning forks is present in both ears.

Hearing by C_2 fork	Right ear	Air 7 seconds.	Air 5 seconds.
	Left ear	Bone 4 seconds.	Bone 4 seconds.

C_5 is heard by both ears, but not so clearly by the left.

Weber localized to the right.

Both Mti are retracted and light reflexes absent.

Gellé's test is positive for right ear; negative for the left.

Urine examination negative.

Blood shows some anemia.

The author's diagnosis was a left labyrinthine hemorrhage, of the nature of a vicarious menstruation. *Campbell.*

Circulatory Disturbances Following Ligation of the Internal Jugular Vein in Sinus Thrombosis with Report of a Case.

EAGLETON, Newark, N. J. (*Archives of Otology,* Vol. XXXV., No. 2). A boy aged 9 years, who, since an attack of scarlet fever five years ago, has had intermittent left otitis media purulenta.

During an attack of malaria, when blood examination showed numerous plasmodia malariae, the ear discharge began and disappeared.

The mastoid was opened and found absolutely normal. The sinus was exposed and, well down towards the bulb, it was blackened with a small opening, low down, through which a drop of pus oozed.

The jugular was ligated and this was immediately followed by a profuse flow of blood from the upper wound, soft parts and bone. Firm tamponage was necessary to control this hemorrhage.

On the following day there was marked double optic neuritis although none was present one-half hour prior to operation restlessness and chilly sensation. A general septic condition developed, the whole ligated jugular area was excised, the upper portion being bathed in pus, while the portion below the ligature was filled with a firmly organized, non-septic clot, which extended downwards behind the clavicle.

Great difficulty was experienced in changing dressings, because of the hemorrhage which succeeded any disturbance of the firm packing. Lumbar puncture was twice done and the cerebellum twice explored with negative results. There formed a hernia cerebri; there was irregular, projectile vomiting, vertigo, loss of co-ordination of the left arm and leg, deviation of the tongue, but no loss of flesh; this latter argued against the existence of an abscess, as in the experience of the author, cerebellar abscess is invariably associated with a rapid loss of flesh.

Ten weeks after the primary operation, death supervened.

On autopsy, the left lateral, the torcular, the inner one-fourth of the right and nearly the whole of the superior longitudinal sinuses were all thrombosed.

The hernia cerebri involved nearly the whole of the left lateral lobe of the cerebellum, and extending from it was an

area of softening involving the left lateral portion of the pons. The author ends his report by reviewing the literature where jugular ligation had resulted disastrously. *Campbell.*

What Cases of Chronic Purulent Otitis Require the Radical Operation?

KNAPP, New York (*Archives of Otology,* Vol. XXXV., No. 2). The trend is to greater conservatism. Ballance is the only one who still states that all cases of chronic purulent discharge from the ear should be treated by the complete operation.

Cases of chronic purulent otitis where intracranial complications, stenosis of the canal and acute mastoiditis are present are left out of consideration, because the wisdom of operating under these conditions is self-evident.

An excellent classification is that adopted by the Berlin Ear Clinic, where the cases are divided into two groups: dangerous and non-dangerous. In the former the bone is affected, especially in the attic and antrum. In the latter, the inflammation is more localized to the mucous membrane of the tympanum, a region from which intracranial complications rarely ensue. In disease of the tympanic walls proper, little can be accomplished by operation, and necrosis of the promontory wall had better be left alone.

The operation is urgent when symptoms of headache, nausea and vertigo are associated with, and in relation to, chronic purulent otitis where the bone is found affected, and this is indicated by the characteristics of the discharge and its fetor, and by the otoscopic picture. There is a total defect of the Mt. or the perforation is marginal, the adjoining portion of the annulus eroded, the perforation being situated next to the superior or posterior wall, i. e., contiguous to the attic and antrum. The presence of cholesteatoma is an urgent indication for operation, unless the opening of the accessory cavities into the middle ear is large and there apparently is no tendency to retention.

Operation is indicated when the signs of bone involvement continue after conservative treatment has been followed for a reasonable length of time, and the odor in the discharge persists. If drainage is good, there is no urgency for operation, and one should hesitate where there is defective hearing

The Leucocyte Count in Inflammatory Diseases of the Ear and of the Temporal Bone, and in the Intracranial Complications.

Suckstorff, Hanover, Germany (*Archives of Otology,* Vol. XXXV., No. 2). The leucocyte count in children under 10 years of age is higher than in those who are older.

In serous otitis media, both in adults and children, there is no increased leucocytosis.

In purulent otitis media in young children, the average leucocyte count was 20,150, but we must remember that children react with an increased number of leucocytes to suppurations and other diseases.

In six cases of chronic purulent otitis media, there was no increase of leucocytes.

In mastoiditis without intracranial complications, there is a slight increase in the leucocytes, more marked in children than in adults.

The reason why the leucocyte count is not markedly increased in mastoiditis is probably because the abscess in the mastoid process is surrounded on all sides by bone. The same is true in the case of thick-walled brain abscess, but when this membrane is destroyed at operation, the body reacts by increase of leucocytes.

In meningitis, Rieder believes that the absence of leucocytosis confirms the diagnosis of its being tubercular. Türk found that in purulent cerebro-spinal meningitis and in secondary purulent meningitis, leucocytosis was present.

In two cases of the author's, he was unable to confirm these observations. *Campbell.*

Incorrect Deductions from Experiments with Tuning-forks on the Function of the So-called Sound-conducting Apparatus.

Zimmerman, Dresden (*Archives of Otology,* Vol. XXXV, No. 3). The paper is a criticism of that of Bezold, an abstract of which appears in this number. The author claims that though Bezold's observations are correct his deductions are erroneous.

In testing sound waves of the lower scale, he used tuning forks, which the normal ear hears at a distance of a few cm. away from the meatus, when he should have employed a drum or organ pipe.

The author has recently examined two patients who had been radically operated upon, where the ossicular chain was

wanting and the region of the oral window was covered by a dense membrane. One of these patients was able to hear with both ears. The other was able to hear with one ear the A tuning fork distinctly by air conduction. The significance of the ossicular chain is not, therefore, that of a sound conductor for the deep tones, but it acts as an accommodative apparatus, which is necessary. *Campbell.*

Symptoms and Treatment of Sinus and Jugular Thrombosis with the Report of Five Cases.

KENNON, Norfolk, Va. (*Archives of Otology,* Vol. XXXV, No. 3). The temperature in this affection is that peculiar to pus absorption; if typical, it is characterized by a sudden rise followed by an equally sudden fall. In several instances of the observed cases, there was a gradual rise followed by a gradual fall, extending over a period of from 6 to 12 hours.

Chill may vary from a pronounced rigor to merely chilly sensations of the extremities. It occurred only once in the five cases reported.

Pulse is usually rapid; it rarely gets back to normal even though the temperature does so.

Optic neuritis is rare; it is more frequent in cases of epidural abscess than in sinus thrombosis.

The presence or absence of pulsation is of no significance in determining a thrombus; granulations on the sinus wall argues against its involvement, for this is a barrier which nature has thrown out between the infective process and the blood current. The aid to diagnosis by palpation is in many cases most misleading.

Rapidity of operation is of great importance. The patients, very frequently, are exhausted by disease and bear the anesthetic badly. If the temperature be indicative of sinus involvement, open it at the time of the mastoid operation. Should the thrombus be situated in the bulb, either primarily or secondarily, at once expose and resect the jugular from the facial downward, while the upper end of the vein is brought out of the upper angle of the wound. The neck wound is left open and heals by granulation, the edges being approximated by adhesive strips. *Campbell.*

The Functional Examination of the Hearing with Tuning-forks in Monolateral Deafness, with Deductions on Bone Conduction and the Function of the Sound-conducting Apparatus.

BEZOLD, Munich (*Archives of Otology,* Vol. XXXV, No. 3). In an examination of four patients with a labyrinth defect on one side, while the other side was healthy, and in three with a labyrinth defect on one side with the other side deaf, by means of the continuous tone series, the author was able to show that the supposed hearing of the ear without a labyrinth is nothing but the reflex of the hearing of the other healthy or partly defective ear, brought about by the impossibility of excluding the healthy ear during the examination.

This reflex is situated exclusively in the upper part of the tone series, and extends from the marked octave to the upper hearing limit of the normal ear. The lowest tone limit, which is heard for a moment only by the ear without a labyrinth is situated between a^1 and a on the Bezold-Edelmann tone series.

To demonstrate one-sided deafness, if one finds that the middle tone of the scale a^1 is not perceived or only slight so, and at the same time the lowest part of the scale which is examined with a few deep forks without overtones is found wanting, then we may assume deafness; if in the case of middle-ear suppurations, the hearing for some of these tuning-forks was previously good, then in case of their defect it can be assumed that the suppuration has extended to the labyrinth.

In the examination of the four cases without a labyrinth but with the other ear intact, the tuning forks of the entitre scale up to a^1 were not perceived even when the tuning forks were brought in direct proximity to the ear without a labyrinth.

As regards the upper half of the scale, the perception takes place through the Mt. and the sound-conducting chain, as the auditory canal on the hearing side cannot be closed sufficiently tight in order to exclude the sound waves of the upper tones. As to the importance of the sound-conducting apparatus for the transmission of the lower part of the scale, we know that without this apparatus hearing by air conduction is impossible up to the treble octave. *Campbell.*

Two Cases of Grave Complication of Purulent Ear Disease Operated Upon and Reported.

BARR, Glasgow (*Archives of Otology,* Vol. XXXV, No. 3).
1. A fatal case of septic thrombosis of the lateral sinus, sec-

ondary to chronic otitis media purulent a in the left ear, and complicated with septic infarctions in the right lung.

A little girl, aged 7, had a copious fetid discharge from the left ear lasting one year. Prior to admission, she had many severe rigors, with oscillations of temperature from normal to 104° F. She complained of frontal headache, pain in the left side of the neck. Moist rales and tubular breathing was noted about the inferior angle of the right scapula.

On the radical mastoid operation being done, the sigmoid sinus was exposed and found converted into a yellowish sloughy-looking mass, surrounded by and partly filled with pus. The bulb contained a solid thrombus. The sinus was opened and cleared of thrombi but the pulmonary symptoms continued to increase.

On post mortem examination, the septic infarcts in the right lung showed the presence of pneumococci, streptococci and an unrecognized large bacillus.

2. A case of otitic extradural abscess, associated with paralysis of the sixth cranial nerve and double optic neuritis; operation and recovery.

A boy, aged 17, with purulent right middle-ear disease for 16 months, came to the hospital on account of headache, diplopia, paralysis of the external rectus and double optic neuritis.

On radical mastoid operation being done, cholesteatomatous masses were cleared out from antrum, aditus and attic of tympanum.

The sinus wall was covered with granulation tissue and pus, but as there were no signs of general septic infection it was not opened. The sixth nerve paralysis gradually passed off after operation but the optic neuritis was progressive; vision, however, so far is unimpaired. *Campbell.*

Infective Sinus Thrombosis, the Varieties of General Infection and Treatment.

Arnold Knapp, New York (*Archives of Otology,* Vol. XXXV, No. 3). One distinguishes two forms of wound infection from pyogenic organisms. First, the form characterized by metastases, with interrupted, transient infection of the general circulation—pyaemia; and second, the form without metastases, with continuous toxic and bacterial infection of the general circulation.

The first form usually is produced by staphylococci, streptococci, rarely pneumococci, while in the second the streptococcus is most frequently found.

Theoretically, one may speak of a bacterial general infection (bacteremia) or of a toxic general infection (toxemia) according as the one or the other factor predominates. In the bacterial general infection, the bacteria increase in the blood (septicemia). In the toxic form, as in tetanus, the toxins develop at the site of infection and spread over the body.

If at operation one finds periphlebitis of the sigmoid sinus, which has caused no symptoms or remittent fever and chills, one is justified in not attacking the sinus, but awaiting the outcome of the mastoid operation.

If, however, the sinus shows changes in consistency and color suggestive of thrombosis, with the signs of phlebitis, and the symptoms point to a general infection, the sinus must be explored, after being laid bare from the upper knee to near the bulb. If the proximal end of the thrombus is near the bulb and is disintegrated, or where the general infction is severe even though the proximal end looks healthy, the jugular vein should first be ligated at a point above the facial vein.

If the sinus wall be affected (phlebitis), a parietal clot is presumably present. In such a case, treatment varies according to the gravity of the systemic infection.

Primary bulb thrombosis can usually only be diagnosticated by exclusion in the presence of systemic infection, when the sigmoid and other accessible sinuses seem normal and contain fluid blood. *Campbell.*

On Post-operative Pyocyaneus Perichondritis of the Auricle.

TATSUSABURO SARAI, Japan (*Archives of Otology,* Vol. XXXV, No. 2). One of the most unpleasant complications of post-operative ear cases is perichondritis caused by the bacillus pyocyaneus. This obstinate, painful inflammation frequently leads to ugly thickening or deformity of the auricle.

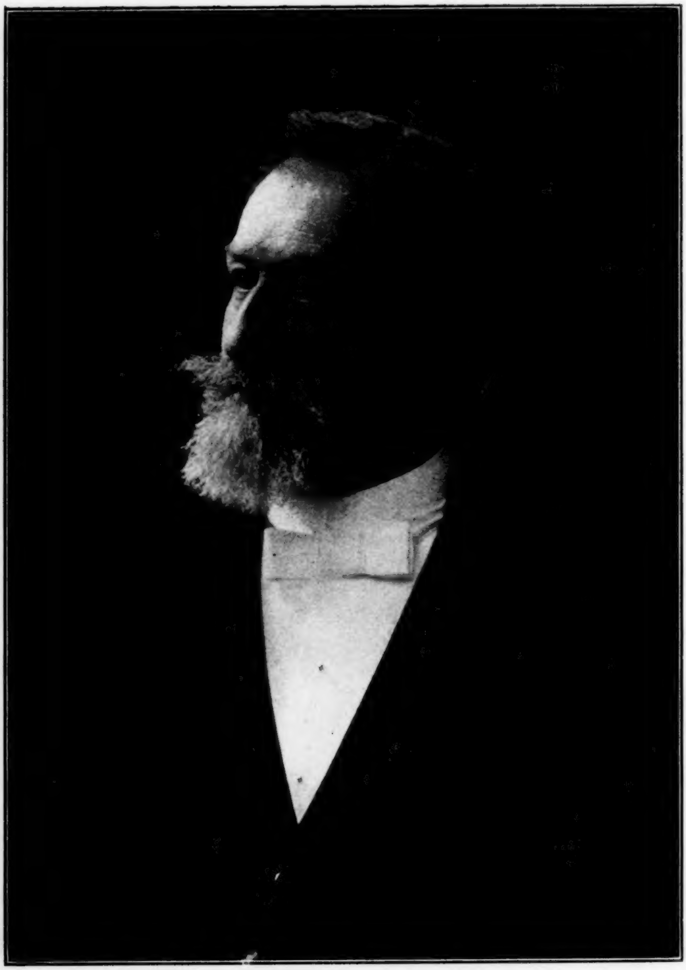
The author's case was that of an anemic girl of 17, upon whom a radical mastoid operation had been performed. Three weeks later the presence of the bacillus pyocyaneus was suspected from the color and the odor of the pus. The dressing of the wound cavity was changed from moist to dry, but before introducing the dry packing a pledget of gauze saturated in

2 per cent silver-nitrate was introduced into the ear for 10 minutes. This is a procedure which has been extremely serviceable in similar cases in the Rostock Ear Clinic.

A few days after the pyocyaneus had been observed, the auricle began to swell, with darting pains and a slight rise of temperature. In a few days, the cavity and cymba conchae were obliterated by the swelling and the inflammation extended to the anterior part of the helix. There was no further extension of inflammation, but two weeks later fluctuation was found in the cavity of the concha. This point was incised and thin flocculent pus escaped. This pus when examined was found to contain the bacillus pyocyaneus in pure culture.

No cartilage was thrown off but a decided thickening of the cavity and cymba concha remained.

Campbell.



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